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**A CATALOGUE OF JAPANESE CEPHALOPODA.**

BY S. STILLMAN BERRY.

## INTRODUCTION.

While engaged in a somewhat comprehensive study of the Cephalopod fauna of the Hawaiian Islands, the writer found himself impelled to consider the possibility of correlation with that of other regions of the Pacific, notably Japan, whence so many bizarre and interesting types have been described. In pursuance of this a simple catalogue was first compiled, then a fairly detailed list of references added, and finally, when the collections of Stanford University proved to be surprisingly rich in material from this region, a mass of other data was accumulated. The greater part of all this is now offered in the present paper. The aim is merely to present a bibliographic catalogue of all the cephalopod mollusks known to occur within the waters of the Japanese Empire, with the addition of a few more or less pertinent notes regarding such species as have chanced to come under the personal observation of the writer.

As already indicated, the bulk of this material was furnished by the zoological collections of Stanford University, where it owes its origin chiefly to the Jordan and Snyder Expedition to Japan in 1900. As the purpose of this expedition was mainly ichthyological, no special effort was made to secure a large collection of cephalopods, but the species which were incidentally obtained are fairly numerous and frequently of considerable interest.

In addition to the above, mention should be made of a small series of cephalopods secured by Dr. David Starr Jordan at Fusan, Korea, in 1911, and a few taken at Takao, Formosa, by Mr. Hans Sauter, which are likewise in the Stanford University collections.

Through the courtesy of Mr. Samuel Henshaw, I have also had the privilege of examining a large series of *Euprymna* from Hong Kong in the Museum of Comparative Zoology.

Lastly, but very fortunately, I have been enabled, through the signal kindness of Prof. A. E. Verrill, to secure the loan of an inextensive but unusually interesting series of small squids, including cotypes of two important species, taken many years ago by Prof.

E. S. Morse in the Bay of Tokio (Yeddo), and now preserved in the Yale University Museum.

#### HISTORICAL SURVEY.

With the possible exception of Tilesius, the honor of being the first author who attempts to refer taxonomically to any Japanese cephalopod belongs, so far as I have been able to ascertain, to Alcide d'Orbigny, who, in the great *Histoire* produced during the years 1834-1839 in collaboration with Férussac, attributed the following-named forms to this region:

<i>Octopus Fang-siao.</i>	<i>Sepiola japonica.</i>
<i>Octopus areolatus.</i>	<i>Sepioteuthis sinensis.</i>
<i>Octopus sinensis.</i>	<i>Sepia sinensis.</i>
	<i>Loligopsis chrysophthalmos.</i>

As the majority of these nominal species were based upon the rude drawings or descriptions of other authors and hence, as a rule, are quite unaccompanied by accurate definition, only the *Octopus areolatus* appears capable of precise determination. All of the other names, with the doubtful exception of *Sepiola japonica*, have dropped from use.

Following the activity of d'Orbigny, we find a long period covering the decades from 1845 to 1885 when but little in regard to this particular field found its way into print save a few exceedingly scattered and fragmentary observations by such authors as Lischke (1869), Tryon (1879), Steenstrup (*Sepia andreana* 1875, *Todarodes pacificus* 1880), Hilgendorf (*Architeuthis martensii* 1880), Owen (1881), and Verrill (*Inioteuthis japonica* and *morsei* 1881).

In the years 1885 and 1886, however, occurred the successive publication by Dr. William E. Hoyle of the important results attained by his exhaustive study of the cephalopods taken during the cruise of H. M. S. "Challenger." In a résumé of the Cephalopoda of the region under consideration (1886, p. 219) some 25 species (one of them doubtful and another since eliminated) belonging to 8 genera are listed. The species added to the fauna include the type of a new genus, 8 other new forms, and several others previously described from other regions, as follows:

<i>Octopus hongkongensis.</i>	<i>Sepia myrsus</i> ?
<i>Octopus januarii.</i>	<i>Sepia esculenta.</i>
<i>Promachoteuthis megaptera.</i>	<i>Sepia kubiensis.</i>
<i>Loligo edulis.</i>	<i>Sepia andreanoides.</i>
<i>Loligo kubiensis.</i>	<i>Sepiella maindroni.</i>
<i>Loligo japonica.</i>	<i>Calliteuthis ocellata</i> (as <i>C. reversa</i> ).

In the meanwhile appeared an important paper by Appellöf (Japanska Cephalopoder, Stockholm, 1886), which is significant as being the first time that we find the cephalopods of Japan dealt with as an assembled unit by themselves. In this paper 8 species were added:

<i>Octopus vulgaris</i> .	<i>Loligo bleekeri</i> .
<i>Octopus globosus</i> n. s.	<i>Loligo sumatrensis</i> .
<i>Octopus macropus</i> .	<i>Sepia peterseni</i> n. s.
<i>Septeuthis lessoniana</i> .	<i>Sepia</i> (= <i>Metasepia</i> ) <i>tullbergi</i> n. s.

Two years later the publication of a second treatise on the same subject from the pen of Dr. A. E. Ortmann (Japanische Cephalopoden, Zool. Jahrb., 1888) marked another notable increase in our knowledge. Thirty-six species referable to 10 genera are accredited to our area, of which the following are first recorded:

<i>Tremoctopus doederleini</i> n. s.	<i>Loligo tetradynamia</i> n. s.
(= <i>Ocythoe tuberculata</i> )	<i>Loligo chinensis</i> .
<i>Octopus kagoshimensis</i> n. s.	<i>Loligo aspera</i> n. s.
<i>Octopus pusillus</i> .	<i>Sepia hoylei</i> n. s.
<i>Microteuthis paradoxa</i> n. s.	<i>Sepia torosa</i> n. s.
(= <i>Idiosepius</i> ).	<i>Sepia tokioensis</i> n. s.

During the next twenty years succeeded another period of only occasional short papers and desultory notes, the most important of which are those of Pilsbry (*Sepia hercules*, 1894), Ijima and Ikeda (*Opisthoteuthis depressa* 1895, *Amphitretus pelagicus* and *Alloposus pacificus* 1902), Mitsukuri and Ikeda (1898), Joubin (1897, 1898), Pfeffer (1900), Nishikawa (1906), Meyer (1906), and Chun (1908, 1910).

Very recently Wülker (1910) has published a third survey of the Japanese members of the group, based upon a portion of the valuable material brought to Germany by Dr. Döflein. In this work, notable for its numerous interesting data and the able manner in which they are presented, Japan is accredited with no less than 24 genera comprising an even 60 species (3 of them doubtful). The following are additions to the fauna:

<i>Tremoctopus violaceus</i> .	<i>Sepia elliptica</i> .
<i>Polypus döfleini</i> n. s.	<i>Sepia lorigera</i> n. s.
<i>Polypus pictus fasciatus</i> .	<i>Sepia misakiensis</i> n. s.
<i>Sepia aculeata</i> .	<i>Sepia appellofi</i> n. s.
	<i>Symplectoteuthis oualaniensis</i> .

In the present catalogue the recognized number is increased to 67 species (4 considered doubtful), falling under 29 genera, with

one somewhat doubtful subspecies. But one new species (*Sepia formosana*) is here proposed, although two others, *Stoloteuthis nipponensis* and *Abraliopsis scintillans* (Berry 1911, 1911a), have previously been described from the same material and are now more fully characterized and figured.

#### RELATIONSHIPS AND DISTRIBUTION.

After the excellent discussion of the relationships of the Japanese cephalopod fauna by Wülker (1910, pp. 23, 24), it would be idle to reënter into the subject with much detail here. Suffice to say that the close analogy there dwelt upon between many Japanese and Mediterranean types is now still further heightened by the addition of *Thelidioteuthis alessandrinii* to the list. Nevertheless, the predominant tone of the fauna is quite decidedly Indo-Malayan. Indeed, outside of the genera *Loligo* and *Sepia*, astonishingly few species are known to be exclusively Japanese, though these two groups here attain such an abundant development and comprise so many unique species that the gross aspect of any large collection from the region is quite characteristic. The presence of the *hongkongensis* group of *Polypi* appears somewhat anomalous and may indicate that these species are invaders from the Aleutian-Californian fauna, where they or their near allies form one of the most striking elements, a conclusion which is, however, by no means to be regarded as certain.

These points are brought out somewhat more forcibly by statement in tabular form.

The distribution of the fauna, according to groups, is significantly shown in the following table:

	Genera.	Species.	Sub-species.	Doubtful.
OCTOPODA .....	7	20	1 ?	2
MYOPSIDA .....	11	35	.....	2
ÆGOPSIDA .....	11	12	.....	.....
TETRABRANCHIATA.....	1	1	.....	.....
Total .....	30	68	1 ?	4

The most striking feature is very obviously the great preponderance of the Myopsida which comprise more species, or at least as many, as all other groups combined. This again is almost entirely due to the more abundant representation of *Loligo* and *Sepia*, and is quite the reverse of the conditions prevailing in other areas of the North Pacific.

Despite the enormous number of recognized species and the fact that no other region of the Pacific has been so diligently investigated, our understanding of the fauna is still so incomplete that this catalogue can scarcely be regarded as any less provisional in nature than its predecessors.

As yet we know almost nothing regarding the distribution of this class of animals along the coasts of northwestern Japan and in the Japan Sea, and but little collecting has been done anywhere on the island of Hokkaido. As is to be expected, the neighboring bays of Tokio, Sagami, and Suruga afford us with the bulk of our information, and the vicinity of Misaki has proven a particularly prolific locality.

NOTE.—In the following pages the sign ! indicates that specimens from the locality cited have been examined and verified by the present author. Numbers enclosed in brackets have reference to the private card register of the author and are given for purposes of convenience and accuracy only. Mere listing of a species in the various catalogues of Hoyle (1886, 1886*a*, 1897, 1909) and of Wülker (1910) has not generally been included in the lists of references.

## Class **CEPHALOPODA.**

Order **DIBRANCHIATA** Owen, 1832.

Sub-order **OCTOPODA** Leach, 1818.

Family **CIRROTEUTHIDÆ** Keferstein, 1866.

Genus **OPISTHOTEUTHIS** Verrill, 1883.

**Opisthoteuthis depressa** Ijima and Ikeda, 1895.

*Opisthoteuthis depressa* Ijima and Ikeda, 1895, pp. 1–15, pl. 33.

*Opisthoteuthis depressa* Meyer, 1906, pp. 758–760 (anatomy).

*Opisthoteuthis depressa* Meyer, 1906*a*, pp. 183–269 [1–93], pls. 11–16 (anatomy).

*Opisthoteuthis depressa* Döflein, 1906, p. 260, fig.

*Opisthoteuthis depressa* Marchand, 1907, p. 381, [77] (anatomy).

*Opisthoteuthis depressa* Dollo, 1912, pp. 131, etc., pl. 3, fig. 5.

*Distribution.*—250 fathoms, Okinose Bank, near Misaki, Sagami (type locality).

Family **ARGONAUTIDÆ** Cantraine, 1840.

Sub-family **ARGONAUTINÆ** s. s.

Genus **ARGONAUTA** Linné, 1758.

The Japanese members of this genus have not yet been carefully worked out, but all three of the names appearing in the literature belong to widely distributed species.

**Argonauta argo** Linné, 1758.

*Argonauta Argo* Linné, 1758, p. 708, Nos. 282, 231.

*Argonauta Argo* Lischke, 1869, vol. I, p. 29 (locality record).

*Argonauta Argo* Dunker, 1882, p. 1 (mere note).

*Argonauta argo* Ortmann, 1888, p. 641.

*Argonauta argo* Jatta, 1896, p. 191, pl. 8, fig. 3; pl. 18, figs. 15-29.

*Argonauta Argo* Hirase, 1907, p. 3 (locality record).

Because of the large number of other species common to both regions, the identity of the Japanese race with typical *A. argo* from the Mediterranean is here assumed, although the fact still remains to be definitely established.

*Distribution*.—Enoshima, Sagami (Ortmann); Tokio (Dunker); Tango (Hirase); Loo-Choo Islands (Lischke). Atlantic, Mediterranean, and Indian Oceans.

**Argonauta hians** Solander, 1786.

*Argonauta hians* Solander, 1786, p. 44, No. 1,055 (*vide* Dall).

*Argonauta hians* Dillwyn, 1817, vol. 1, p. 334.

*Argonauta gondola* Dillwyn, 1817, vol. 1, p. 335.

*Argonauta gondola* Lischke, 1869, vol. I, p. 29 (mere note).

*Argonauta gondola* Dunker, 1882, p. 1 (mere note).

*Argonauta hians* Ortmann, 1888, p. 641.

*Distribution*.—Enoshima, Sagami (Ortmann); Sagami (Hirase); Loo-Choo Islands (Lischke). Indo-Pacific, South Atlantic, etc.

**Argonauta hians navicula** Solander, 1786.

*Argonauta navicula* Solander, 1786, p. 44, No. 1,055 (*vide* Dall).

*Argonauta Oweni* Adams and Reeve, 1850, p. 4, pl. 3, figs. 1a-1d.

*Argonauta Owenii* Dunker, 1882, p. 1 (mere note).

*Argonauta hians navicula* Dall, 1908, pp. 226, 229.

*Distribution*.—Japan (Dunker). South Atlantic, Indo-Pacific, etc.

## Sub-family OCYTHOINÆ.

Genus **OCYTHOE** Rafinesque, 1814.**Ocythoe tuberculata** Rafinesque, 1814.

*Ocythoe tuberculata* Rafinesque, 1814, p. 29.

*Tremoctopus döderleini* Ortmann, 1888, p. 642, pl. 20.

*Ocythoe tuberculata* Jatta, 1896, p. 198, pl. 6, fig. 3; pl. 7, fig. 8; pl. 19, figs. 1-12; text figs. 14, 52.

*Ocythoe tuberculata* Wülker, 1910, p. 4.

The *Tremoctopus döderleini* of Ortmann, which is obviously not a *Tremoctopus* in the accepted sense of the term, is said by Wülker to be identical with the common Mediterranean *O. tuberculata*. The reported dispersal of the species is somewhat peculiar and indicates that it will eventually prove to be nearly cosmopolitan.

*Distribution*.—Bay of Tokio (Ortmann); near Misaki, Sagami (Wülker); near Aburatsubo, Sagami (Wülker). Mediterranean Sea; Vineyard Sound, Massachusetts (Verrill); West Indies (*vide* Verrill).

## Sub-family TREMOCTOPODINÆ.

Genus **TREMOCTOPUS** Delle Chiaje, 1829.**Tremoctopus violaceus** Delle Chiaje, 1829.*Tremoctopus violaceus* Delle Chiaje, 1829, pls. 70, 71 (*vide* Wülker).*Tremoctopus violaceus* Jatta, 1896, p. 204, pl. 6, fig. 2; pl. 20, figs. 1-18.*Tremoctopus violaceus* Wülker, 1910, p. 5.*Distribution*.—Coast of Boshu, Sagami Sea (Wülker). Mediterranean Sea.Family **POLYPODIDÆ** Hoyle, 1904.Genus **POLYPUS** Schneider, 1784.

That the genus *Polypus* attains an especially large development on the coasts of Japan is attested by the formidable list of names which have at one time or another been ascribed to this area, and that despite the fact that, so far as members of this group are concerned, the deeper waters off shore are still practically a *terra incognita*, *P. januarii* being the only abyssal species thus far reported. However, the true number belonging to the fauna is somewhat obscured by the lack of sufficient diagnosis or other needful information respecting several of the alleged species. The following list is thought to include all the names which occur in the literature:

<i>Polypus vulgaris</i> Lamarck.	<i>P. hongkongensis</i> Hoyle.
<i>P. granulatus</i> Lamarck (= <i>rugosus</i> Bosc.).	<i>P. döfleini</i> Wülker.
<i>P. macropus</i> Risso (= <i>cuvieri</i> d'Orbigny).	<i>P. pictus fasciatus</i> Hoyle.
<i>P. kagoshimensis</i> Ortmann.	<i>P. areolatus</i> De Haan.
<i>P. globosus</i> Appellöf.	<i>P. ocellatus</i> Gray.
<i>P. pusillus</i> Gould.	<i>P. brocki</i> Ortmann.
<i>P. januarii</i> Steenstrup.	<i>P. fang-siao</i> d'Orbigny. <sup>1</sup>
	<i>P. sinensis</i> d'Orbigny. <sup>1</sup>
	<i>P. membranaceus</i> Quoy and Gaimard.

**Polypus vulgaris** (Lamarck, 1799).*Octopus vulgaris* Lamarck, 1799, p. 18 (*vide* Jatta).*Octopus octopodia* Tryon, 1879, p. 113, pl. 23, figs. 3, 4 (after d'Orbigny); pl. 24, figs. 5, 6 (after d'Orbigny); pl. 24, fig. 7 (after Jeffreys).*Octopus vulgaris* Appellöf, 1886, p. 7.*Octopus vulgaris* Ortmann, 1888, p. 642.*Polypus vulgaris* Wülker, 1910, p. 5.

As I have had no European specimens of *P. vulgaris* available for comparison, I cannot feel personally certain that the following specimens are correctly referred to this species, but I think little doubt exists that they are conspecific with the form so identified

<sup>1</sup> *Octopus Fang-siao* and *Octopus sinensis* are names applied by d'Orbigny to certain rude illustrations of Chinese or Japanese origin and published by him without any real diagnosis. They are nearly or quite unrecognizable and probably can never have any standing. Appellöf has suggested that *O. Fang-siao* belongs to the synonymy of *O. ocellatus*. Tryon refers *O. sinensis* without hesitation to *O. membranaceus*, Hoyle somewhat dubiously unites it with *O. areolatus*, while Appellöf places it with a query under *O. vulgaris*.



by the various other writers on Japanese cephalopods. The fact that the lateral arms are usually notably longer than the others, the minute conical hectocotylus, reticulate surface, and reddish-gray color seem to be very characteristic. The lateral arms in the male show a conspicuous enlargement of one or (occasionally) more of the suckers near the umbrella margin, as has been noted in numerous other species.

The dimensions of two ♂ specimens are given below:

	[No. 339]	[No. 337]
	mm.	mm.
Total length to tip of arms.....	610 <sup>2</sup>	355 <sup>2</sup>
Length of mantle (dorsal).....	101	71
Width of mantle.....	85	60
Width of neck.....	47	39
Width of head.....	53	40
Length of funnel.....	45	33
Length of right dorsal arm, outside measurement.....	395 <sup>2</sup>	220 <sup>2</sup>
Length of left dorsal arm, outside measurement.....	410 <sup>2</sup>	200 <sup>2</sup>
Length of right second arm, outside measurement.....	470+ <sup>2</sup>	265 <sup>2</sup>
Length of left second arm, outside measurement.....	440 <sup>2</sup>	245 <sup>2</sup>
Length of right third arm, outside measurement.....	380 <sup>2</sup>	205 <sup>2</sup>
Length of left third arm, outside measurement.....	420 <sup>2</sup>	250 <sup>2</sup>
Length of right ventral arm, outside measurement.....	380 <sup>2</sup>	230 <sup>2</sup>
Length of left ventral arm, outside measurement.....	380 <sup>2</sup>	225 <sup>2</sup>
Length of hectocotylus.....	4	3
Length of umbrella between dorsal arms.....	55	50
Length of umbrella between ventral arms.....	70	35
Diameter of largest sucker.....	20	13

*Material Examined.*—

No. Sp.	Locality.	Sex.	Collectors.	Where deposited.	Author's Register.
1	Misaki, Sagami.....	♂	Jordan and Snyder	L.S.J.U., Cat. 2,000	336
1	Misaki, Sagami.....	♀	Jordan and Snyder	L.S.J.U., Cat. 2,001	345
1	Bay of Waka, Kii.....	♀	Jordan and Snyder	L.S.J.U., Cat. 2,002	335
3	Tsuruga, Echizen.....	♀	Jordan and Snyder	L.S.J.U., Cat. 2,004	338
1	Tsuruga, Echizen.....	♂	Jordan and Snyder	L.S.J.U., Cat. 2,003	339
3	Tsuruga, Echizen.....	2♂ 1♀	Jordan and Snyder	Not re- tained	340
2	Fusan, Korea.....	♂	D. S. Jordan	L.S.J.U., Cat. 2,005	337
1	Fusan, Korea.....	♀	D. S. Jordan	L.S.J.U., Cat. 2,006	334

<sup>2</sup> Measurements necessarily inaccurate.

*Distribution*.—Bay of Tokio (Ortmann); Misaki, Sagami ! (Wülker); Nagasaki (Appellöf); Bay of Waka, Kii (!); Tsuruga, Echizen (!); Fusan, Korea (!). Nearly cosmopolitan in the Atlantic, Mediterranean, and Indian Oceans.

**Polypus granulatus** (Lamarck, 1799).

- Sepia rugosa* Bosc., 1792, p. 24, pl. 5, figs. 1, 2 (*vide* Hoyle).  
*Octopus granulatus* Lamarck, 1799, p. 20.  
*Octopus rugosus* Brock, 1887, p. 605.  
 ? *Octopus kagoshimensis* Ortmann, 1888, p. 644, pl. 21, fig. 2.  
*Octopus rugosus* Ortmann, 1891, p. 669.  
*Octopus granulatus* Joubin, 1897*a*, p. 99.  
*Polypus granulatus* Wülker, 1910, p. 5.

An almost cosmopolitan species characterized by its short, sub-equal arms, only about double the length of the body (Brock), and usually having the formula 4, 3, 2, 1; the warted surface (apparently a very variable feature), coloration, etc. I have not discovered this form in any of the material at my disposal.

*Distribution*.—Washinokami, Rikuzen (Wülker); Misaki, Sagami (Wülker); Nagasaki, Hizen (Joubin). Atlantic, Indo-Pacific, etc.

[**Polypus kagoshimensis** (Ortmann, 1888).]

- Octopus kagoshimensis* Ortmann, 1888, p. 664, pl. 21, fig. 2.  
*Octopus rugosus* (pars) Ortmann, 1891, p. 669.  
*Polypus granulatus* (pars ?) Wülker, 1910, p. 6.

Three years after its description this species was referred by Ortmann himself to *O. rugosus* Bosc. (*granulatus*), and the same course has been somewhat doubtfully followed by Wülker.

*Distribution*.—Kagoshima (type locality, Ortmann).

**Polypus globosus** (Appellöf, 1886).

- Octopus globosus* Appellöf, 1886, p. 7, pl. 1, figs. 4, 5.  
*Octopus globosus* Ortmann, 1888, p. 662.  
*Octopus rugosus* (pars) Ortmann, 1891, p. 669.  
*Octopus globosus* Goodrich, 1896, p. 19, pl. 5, fig. 81 (hectocotylus).  
*Octopus globosus* Joubin, 1897*a*, p. 98.  
*Octopus globosus* Appellöf, 1898, p. 565.  
*Polypus globosus* Hoyle, 1909, p. 259 (no description).

This is a rather small species belonging to the same group as *P. granulatus* and *P. kagoshimensis*. It has been united with *P. rugosus* (*granulatus*) by Ortmann, but this disposition has since been vigorously combated by Appellöf.

*Distribution*.—Nagasaki, Hizen (Appellöf). Ternate (Appellöf); Straits of Malacca (Goodrich); Kabusa Is. (Goodrich); Nicobar Is. (Goodrich); Bombay (Goodrich); Point Galle, Ceylon (Goodrich).

**Polypus pusillus** (Gould, 1852).

*Octopus pusillus* Gould, 1852, p. 478, fig. 591.

*Octopus pusillus* Tryon, 1879, p. 112, pl. 31, figs. 31-33.

*Octopus pusillus* Ortmann, 1888, p. 644, pl. 21, fig. 1.

? *Polypus pusillus* Hoyle, 1904, p. 16, pl. 4, fig. 5.

The identity and important characters of this species are scarcely yet established upon a firm basis, for it seems to me questionable whether the Western Pacific specimens referred by Hoyle (1904) to *P. pusillus* are really conspecific with Gould's type. The relatively wide umbrella (one fourth as long as the arms) arm formula 1, 2, 3, 4, lack of cirri, smooth skin, and large, prominent eyes appear to be the most salient features noted in Gould's description.

*Distribution*.—Kagoshima, Satsuma (Ortmann). Mangsi Islands, China Sea (type locality, Gould); off the southwest coast of Central America (Hoyle).

**Polypus macropus** (Risso, 1826).

*Octopus macropus* Risso, 1826, vol. 4, p. 3 (*vide* Hoyle).

*Octopus Cuvierii* d'Orbigny, in d'Orbigny and Férussac, 1826, Poulpes, pl. 4 (*vide* Hoyle).

*Octopus Cuvieri* Appellöf, 1886, p. 6, pl. 1, fig. 6.

*Octopus macropus* Hoyle, 1886, pp. 11, 95.

*Octopus macropus* Ortmann, 1888, p. 643, pl. 21, fig. 3 (hectocotylus).

*Octopus macropus* Joubin, 1897a, p. 99.

*Polypus macropus* Wülker, 1910, p. 8.

The loose, soft, elongate body; long, attenuate, and very unequal arms; short umbrella; curiously formed hectocotylus, and nearly smooth surface serve to distinguish *P. macropus* from any of its Japanese congeners. The arms of the various pairs are conspicuously different in proportion, their order persistently 1, 2, 3, 4, and the dorsal pair much the stoutest and longest. The right third arm of the ♂ is scarcely half as long as its mate of the opposite side and terminates in an extremely conspicuous, oblong, trough-shaped hectocotylus, ornamented with perhaps 8 or 9 prominent transverse ridges on its inner surface and so thickened as to greatly exceed the adjacent portion of the arm in diameter.

The skin is in general smooth, but the present material shows usually about three small conical tubercles just above and behind each eye-opening, with a few scattered smaller ones occasionally apparent over the rest of the dorsum.

The more important measurements of two specimens are given below, both being males:

	No. 327. mm.	No. 325. mm.
Length, total.....	225	320
Length of mantle, dorsal.....	75	45
Width of mantle.....	30	29
Width of neck.....	13	15
Width of head.....	21	20
Length of funnel.....	41	30
Length of right dorsal arm (outside measurement)....	390	140+
Length of left dorsal arm (outside measurement).....	435	255
Length of right second arm (outside measurement)....	300+	195
Length of left second arm (outside measurement).....	305	190+
Length of right third arm (outside measurement).....	140	90
Length of left third arm (outside measurement).....	245	170
Length of right ventral arm (outside measurement). ..	175+	156
Length of left ventral arm (outside measurement). ....	215	152
Length of hectocotylus.....	20	9
Width of hectocotylus.....	7	3.5
Width of umbrella between dorsal arms.....	65	34
Width of umbrella between ventral arms.....	30	26

*Distribution.*—Hakodate, Oshima (!); Aomori, Mutsu (!); Matsushima, Rikuzen (!); Bay of Tokio (Ortmann); Misaki, Sagami (Wülker !); Yokohama (Hoyle); Bay of Waka, Kii (!); Nagasaki, Hizen (Appellöf).

Canary Islands, Mediterranean Sea, etc. As this species has also been recorded from the Red Sea, Bay of Bengal, Straits of Malacca, and various other localities, its area of distribution appears to form a continuous belt along the entire southern and south-western shores of the Eurasian continent. It is represented in the Stanford University collections by an excellent series of specimens from the following localities:

No. Sp.	Locality.	Sex.	Collectors.	Where deposited.	Author's Register.
1	Hakodate, Oshima.....	♂	Jordan and Snyder	L.S.J.U., Cat. 2,007	328
2	Aomori, Mutsu.....	♂	Jordan and Snyder	L.S.J.U., Cat. 2,008	325
3	Matsushima, Rikuzen.....	♀ 2♂	Jordan and Snyder	L.S.J.U., Cat. 2,009	327
?1	Misaki, Sagami.....	♀	Jordan and Snyder	L.S.J.U., Cat. 2,011	346
1	Bay of Waka, Kii.....	♀	Jordan and Snyder	L.S.J.U., Cat. 2,010	326

**Polypus hongkongensis** (Hoyle, 1885).

? *Octopus punctatus* Gabb, 1862, p. 170 (not of Blainville, 1826).

*Octopus hongkongensis* Hoyle, 1885a, p. 224.

*Octopus hongkongensis* Hoyle, 1885c, p. 99.

*Octopus punctatus* Hoyle, 1886, pp. 11, 100, etc., pl. 5.

*Octopus punctatus* Ortmann, 1888, p. 662.

*Octopus punctatus* Joubin, 1897, p. 110, pl. 9.

*Octopus punctatus* Joubin, 1897a, p. 98.

*Polypus punctatus* Wülker, 1910, p. 7.

Wülker cites the enormous elongate hectocotylus ( $\frac{1}{3}$  or more the length of the arm) and the very long arms (7 times the ventral mantle length) as perhaps the most conspicuous features which may be depended upon to distinguish this very distinct species. I am not at all convinced that the Eastern Asiatic species is really identical with the *O. punctatus* Gabb of California, although without doubt they are very closely related.

*Distribution*.—345 fathoms, off Ino Sima Island (type locality, Hoyle); Aburatsubo, Sagami (Wülker). Hong Kong, China (Hoyle); Kamtschatka (Joubin).

**Polypus döfleini** Wülker, 1910.

*Polypus döfleini* Wülker, 1910, p. 7, pl. 2, figs. 1, 2; pl. 3, fig. 10.

A species of the *hongkongensis* group distinguished by its relatively moderate arms (4 times the ventral mantle length) and decidedly smaller hectocotylus (one-sixteenth as long as the arm).

*Distribution*.—Todohokke, Oshima (type locality, Wülker).

**Polypus** sp. Young.

Catalogue No. 2,012, Stanford University Invertebrate Series, contains four small ♂ *Polypi* taken by Snyder and Sindo at Tanegashima Island, Japan [S. S. B. No. 344]. These agree briefly in the following characters, but I am unable to refer them with certainty to any of the described species:

Body plump, firm, rounded; head short and broad. Dorsal surface finely and quite evenly granulose with numerous minute, acute, pointed papillæ; one or two larger ones over each eye; smooth below.

Arms moderate, subequal, evenly tapering, about three times as long as the head and body, their order 3 = 2, 4, 1. Suckers large, crowded; one or two of those just inside the web margin on the lateral arms a little larger than the rest, but not abruptly or conspicuously so. Hectocotylized arm scarcely at all shorter than its mate of the opposite side; the terminal organ very small, smooth, elongate, spoon-shaped. Umbrella short, about equally developed all around.

Color a dark blackish slate, paler below and within the arms.

*Measurements.*

	mm.	mm.	mm.
Total length.....	106	85	78
Length of mantle (dorsal).....	18	15	15
Width of mantle.....	20	15	14
Width of neck.....	14	11.5	10.5
Width of head.....	15	14	13
Length of funnel.....	10	9	6
Length of right dorsal arm.....	70	56	50
Length of left dorsal arm.....	71	55	49
Length of right second arm.....	75+	64	54
Length of left second arm.....	83	65	54
Length of right third arm.....	78	65	60
Length of left third arm.....	84	65	60
Length of right ventral arm.....	75	58+	58
Length of left ventral arm.....	75	58	61
Length of hectocotylus.....	3	3	3
Length of umbrella between dorsal arms.....	14	14	8
Length of umbrella between ventral arms.....	11	12	8

These specimens in certain ways suggest the *P. globosus* of Appellöf, but the order of the arms is decidedly different, and the hectocotylus, though very much smaller, is of a similar type to that prevailing in the *hongkongensis* group. The possibility has not been overlooked that they may be young *P. döfleini*, but here again the arm formulæ fail to coincide.

***Polypus januarii*** (Steenstrup, 1885).

*Octopus januarii* "Steenstrup, MS.," Hoyle, 1885a, p. 229.

*Octopus januarii* "Steenstrup, MS.," Hoyle, 1885c, p. 105.

*Octopus januarii* Hoyle, 1886, pp. 11, 76, 97, etc., pl. 7, fig. 4.

*Octopus Januarii* Goodrich, 1896, p. 19.

*Polypus januarii* Hoyle, 1904, p. 18, pl. 5, fig. 2 (radula).

A very distinct species, well differentiated from all other Japanese *Polypi* by its soft, smooth integument, pinkish color, swollen eyes, extensive umbrella, short conical hectocotylus, and abyssal habit. It has been taken in this region only by the "Challenger," which secured a single ♂ specimen at a depth of 1875 fathoms in the North Pacific east of Japan (Hoyle, 1886).

*Distribution*.—North Pacific, east of Japan (Hoyle). Off Barra Grande, Brazil (type locality, Hoyle); Rio de Janeiro, Brazil (Hoyle); Bay of Bengal (Goodrich); Andaman Sea (Goodrich); off the Cocos Islands (Hoyle).

**Polypus pictus fasciatus** (Hoyle, 1886).

*Octopus pictus* var. *fasciata* Hoyle, 1886, p. 94, pl. 8, fig. 3.

*Octopus pictus* var. *fasciata* Goodrich, 1896, p. 19, pl. 5, fig. 82 (hectocotylus).

*Polypus pictus* var. *fasciata* Wülker, 1910, p. 6.

Characterized by its conspicuous and definite color pattern comprising various bands of pigment on the body and series of roundish blotches along the outer surfaces of the arms.

*Distribution*.—Aburatsubo, Sagami (Wülker). Port Jackson, Australia (type locality, Hoyle, Goodrich).

**Polypus ocellatus** (Gray, 1849).

*Octopus ocellatus* d'Orbigny, in d'Orbigny and Férussac, Poulpes, pl. 9, upper fig. (*vide* Gray).

*Octopus ocellatus* Gray, 1849, p. 15.

*Octopus membranaceus* Tryon (*pars*), 1879, p. 285 (merely listed), pl. 29, fig. 8.

*Octopus ocellatus* Appellöf, 1886, p. 8, pl. 1, figs. 1-3.

*Octopus areolatus* Hoyle (*pars*), 1886, pp. 8, 86.

*Octopus ocellatus* Brock, 1887, pp. 608, 611.

*Octopus ocellatus* Ortmann, 1888, p. 662 (mere note).

*Octopus ocellatus* Joubin, 1898, p. 22.

The status of this species is still very uncertain as it is not quite apparent whether the *Octopus ocellatus* Gray is the same as the Chinese drawing to which the same name was previously applied by d'Orbigny, or whether the *O. ocellatus* Appellöf is in turn identical with that of Gray. Tryon refers Gray's species to *O. membranaceus*, while Hoyle places *O. ocellatus* of both Gray and Appellöf in the synonymy of *O. areolatus*. However, Appellöf's determination has been called in question by Brock.

Wülker, the most recent writer on the subject, lists the species as *P. ocellatus* Gray.

*Distribution*.—Nagasaki, Hizen (Appellöf); China Sea (type locality, Gray).

**Polypus areolatus** (de Haan, 1838).

*Octopus areolatus* de Haan MS., 1835 (*vide* d'Orbigny).

*Octopus areolatus* d'Orbigny, in d'Orbigny and Férussac, 1838, p. 65.

? *Octopus sinensis* d'Orbigny, in d'Orbigny and Férussac, 1838, p. 68, pl. 9.

*Octopus areolatus* d'Orbigny, 1845, p. 186.

? *Octopus ocellatus* Gray, 1849, p. 15.

*Octopus areolatus* Hoyle, 1886, pp. 8, 86, 205, etc., pl. 3, figs. 6, 7.

*Octopus areolatus* Brock, 1887, pp. 610, 611.

*Octopus brocki* Ortmann, 1888, p. 645.

*Octopus areolatus* Ortmann, 1888, p. 662.

*Octopus areolatus* Joubin, 1894, p. 28.

*Octopus areolatus* Joubin, 1898, p. 22.

*Polypus areolatus* Hoyle, 1904, p. 16.

*Polypus areolatus* Wülker, 1910, p. 6.

*P. areolatus* is a small species with a compact, pyriform body, widest posteriorly, and with a conspicuous ventral furrow. The head is small and weakly differentiated from the body. The dorsal

surface is quite heavily and evenly papillose with either (1) soft polygonal tubercles, or (2) almost a shagreen of small stellate warts, or (3) fairly smooth when poorly preserved. Ventrally the papillæ become nearly obsolete. A group of two large and several smaller papillæ surmounts either eye.

The arms are almost of a length, the second pair slightly longer than the others, but not much more than twice as long as the head and body taken together. They taper evenly to slender extremities. In the male the third right arm is only a little shorter than its mate. The very ample marginal canal is transversely striate within and terminates in a faint groove running down the inner face of the small naked elongate-conical hectocotylus. One sucker of the fifth or sixth pairs on each lateral arm shows a conspicuous enlargement.

The color of preserved specimens is a dark slaty-brown, paler below and on the inner surface of the umbrella. Obliquely in front

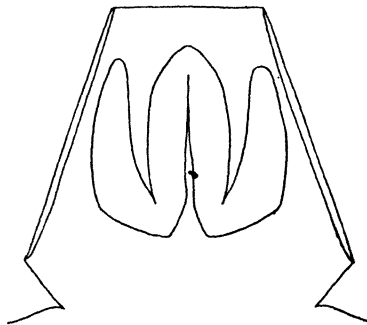


Fig. 1.—*Polypus areolatus*, outline drawing of funnel organ,  $\times 2$ ; [148].

of and below the eye on either side is a conspicuous eye-like spot, comprising a dark outer ring enclosing within it a narrower ring of a lighter color (usually bluish and showing a faint metallic lustre), and within this a central zone of the same dark shade as the outer ring. There is also a definable but less conspicuous ovoid spot between the eyes of a lighter and browner tint than the general surface. The ocular markings of the six specimens in the Stanford University collection seem much larger than those of the animal figured by Hoyle in the Challenger Report, but I have no doubt but that they are correctly referred to the same species.

The measurements of a well-preserved male are given below, the specimen referred to being No. 148 of the author's register.



	mm.
Total length.....	203
Length of body (dorsal).....	42
Width of body.....	35
Width of neck.....	20
Width of head.....	21
Length of funnel.....	20
Length of right dorsal arm (inside measurement).....	134
Length of left dorsal arm (inside measurement).....	130
Length of right second arm (inside measurement).....	85+
Length of left second arm (inside measurement).....	142
Length of right third arm (inside measurement).....	120
Length of left third arm (inside measurement).....	121+
Length of right ventral arm (inside measurement).....	125
Length of left ventral arm (inside measurement).....	120+
Length of hectocotylus.....	7
Length of umbrella between dorsal arms.....	28
Length of umbrella between ventral arms.....	24
Dimensions of ocular spot of right side.....	7 x 12

Ortmann separates his *P. brocki* from *P. areolatus* on account of (1) the larger ocular spots; (2) the nearly smooth skin; (3) the unusual enlargement of the suckers, and (4) the presence of a brown spot between the eyes. Wülker considers part of these characters due to the preservation and suggests that the remainder are equally applicable to *P. areolatus*. The present specimens bear out this opinion very fairly.

*Distribution*.—Aomori, Mutsu (!); Tsuruga, Echizen (!); Tokio (!); 100 meters off Misaki, Sagami (Wülker); 110 meters off Dzushi, Sagami (Wülker); Bay of Waka, Kii (!); Kagoshima, Satsuma (Ortmann). Hong Kong (Hoyle); south of Papua (Hoyle).

*Material Examined*.—

No. Sp.	Locality.	Sex.	Collectors.	Where deposited.	Author's Register.
2	Aomori, Mutsu.....	♂	Jordan and Snyder	L.S.J.U., Cat. 2,013	329
1	Tsuruga, Echizen.....	♂	Jordan and Snyder	L.S.J.U., Cat. 2,014	148
1	Tokio.....	♂	Jordan and Snyder	L.S.J.U., Cat. 2,015	347
1	Bay of Waka, Kii.....	♀	Jordan and Snyder	L.S.J.U., Cat. 2,017	330

A specimen entered as L. S. J. U., Cat. 2,018 (S. S. B. No. 332), collected by Jordan and Snyder at Tsuruga, Echizen, is not only much larger than any of the specimens above referred to *P. areolatus*,

but differs from them so conspicuously in several quite important characters that I feel considerable uncertainty as to whether it is specifically identical with them.

There is a large irregular tubercle over each eye, but except for this the skin is almost perfectly smooth. At various points on the dorsal surface, however, are to be observed a few small scattered pit-like indentations resembling impressed papillæ, most conspicuous being a diamond-shaped group of four on the middle of the back. The arms are about three and a half times as long as the head and body and very unequal, though this appears to be due to the fact that many of them have been mutilated and are undergoing regeneration. The enlarged suckers and hectocotylus are similar to those just described for *P. areolatus*. The color is exceedingly dark and the heavy pigmentation extends over even the inner surfaces of the arms and periphery of the suckers, so that the pale inner surfaces of the latter stand out very conspicuously against the slate-colored background. The ocular markings are nearly circular, and the inner light colored ring is nearly as wide as the one enclosing it. There are also traces of another light colored zone or ring outside the latter. The inmost dark core is conspicuously smaller than in the specimens described above.

The dimensions are as follows:

	mm.
Total length.....	340
Length of body (dorsal).....	53
Width of body.....	50
Width of neck.....	32
Width of head.....	37
Length of right dorsal arm.....	230
Length of left dorsal arm.....	260
Length of right second arm.....	200
Length of left second arm.....	265
Length of right third arm.....	102 <sup>3</sup>
Length of left third arm.....	160 <sup>3</sup>
Length of right ventral arm.....	110 <sup>3</sup>
Length of left ventral arm.....	240
Length of hectocotylus.....	3 <sup>3</sup>
Length of umbrella between dorsal arms.....	33
Length of umbrella between ventral arms.....	32
Diameter of oculation, maximum.....	11½ x 14
Diameter of oculation, excluding outermost light ring.....	8 x 10

<sup>3</sup> Regenerating.

[*Polypus membranaceus* (Quoy and Gaimard, 1832).]

- Octopus membranaceus* Quoy and Gaimard, 1832, p. 89, pl. 6, fig. 5.  
*Octopus membranaceus* d'Orbigny and Férussac, 1838, p. 43, Poulpes, pls. 10, 28 (*fide* d'Orbigny).  
*Octopus membranaceus* d'Orbigny, 1845, p. 181.  
*Octopus membranaceus* Gray, 1849, p. 13.  
*Octopus membranaceus* Tryon, 1879, p. 124, pl. 28, figs. 20, 21.  
*Amphioctopus membranaceus* Fischer, 1882, p. 333.  
*Octopus membranaceus* Brock, 1887, pp. 609, 612.  
*Octopus membranaceus* Ortmann, 1888, p. 662 (mere note).  
*Octopus areolatus* Joubin (*pars*), 1894, p. 28.

Reported from Japan by Tryon, who included with this species as synonyms the *O. ocellatus* and *O. sinensis* of d'Orbigny. The occurrence of undoubted *membranaceus* in this region needs confirmation.

Family **AMPHITRETIDÆ** Hoyle, 1886.

Genus **AMPHITRETUS** Hoyle, 1885.

**Amphitretus pelagicus** Hoyle, 1885.

- Amphitretus pelagicus* Hoyle, 1885, p. 271, fig. 106.  
*Amphitretus pelagicus* Hoyle, 1885a, p. 235.  
*Amphitretus pelagicus* Hoyle, 1885c, p. 113, fig.  
*Amphitretus pelagicus* Hoyle, 1886, pp. 4, 67, etc., pl. 9, figs. 7-9.  
*Amphitretus pelagicus* Ijima and Ikeda, 1902, pp. 85-101, text figs. 1-3, pl. 2.

*Distribution*.—Okinose Bank, near Misaki, Sagami (Ijima and Ikeda). Off the Kermadec Islands (type locality, Hoyle).

Family **ALLOPOSIDÆ** Verrill, 1881.

Genus **ALLOPOSUS** Verrill, 1881.

**Alloposus pacificus** Ijima, 1902.

*Alloposus pacificus* Ijima in Ijima and Ikeda, 1902, p. 87, note.

A species not yet sufficiently characterized.

*Distribution*.—Sagami Sea (type locality, Ijima).

Sub-order DECAPODA Leach, 1818.

Division MYOPSIDA d'Orbigny, 1845.

Family **LOLIGINIDÆ** Steenstrup, 1861.

Genus **LOLIGO** Schneider, 1784.

Among cephalopods only *Polypus* and *Sepia* exceed the widespread genus *Loligo*, in the number of species known from Japanese waters. The following species have been described or identified from this region:

- |                       |                          |
|-----------------------|--------------------------|
| <i>L. edulis</i> .    | <i>L. sumatrensis</i> .  |
| <i>L. chinensis</i> . | <i>L. japonica</i> .     |
| <i>L. kubiensis</i> . | <i>L. tetradynamia</i> . |
| <i>L. bleekeri</i> .  | <i>L. aspera</i> .       |

**Loligo edulis** Hoyle, 1885.*Loligo edulis* Hoyle, 1885*b*, p. 186.*Loligo edulis* Hoyle, 1885*d*, p. 289.*Loligo edulis* Hoyle, 1886, pp. 29, 152, etc., pl. 23.*Loligo edulis* Ortmann, 1888, pp. 658, 663.*Loligo edulis* Brazier, 1892, p. 16 (locality record).

Three specimens in the collections examined agree very fairly with the description given by Hoyle. Two lots of young individuals are referred provisionally to the same species.

*Distribution*.—Aomori, Mutsu (!); Same, Mutsu (!); Bay of Tokio (!); Yokohama (type locality, Hoyle); Bay of Waka, Kii (!). Port Jackson, Australia (Brazier).

*Material Examined*.—

No. Sp.	Locality.	Sex.	Collectors.	Where deposited.	Author's Register.
1	Bay of Tokio.....	♀	E. S. Morse	Yale Univ. Mus., Cat. 9,641	363
2	Bay of Waka, Kii.....	♂	Jordan and Snyder	L.S.J.U., Cat. 2,030	372
?36	Aomori, Mutsu.....	juv.	Jordan and Snyder	L.S.J.U., Cat. 2,028	373
? 4	Same, Mutsu.....	juv.	Jordan and Snyder	L.S.J.U., Cat. 2,029	374

**Loligo chinensis** Gray, 1849.*Loligo chinensis* Gray, 1849, p. 74.*Loligo chinensis* Tryon, 1879, p. 145.*Loligo chinensis* Ortmann, 1888, pp. 657, 665, pl. 24; pl. 25, figs. 2*a*–2*d*.

*Distribution*.—Bay of Tokio (Ortmann); Kadsiyama (Ortmann). China (type locality, Gray).

**Loligo kubiensis** Hoyle, 1885.*Loligo kubiensis* Hoyle, 1885*b*, p. 184.*Loligo kubiensis* Hoyle, 1885*d*, p. 287.*Loligo kubiensis* Hoyle, 1886, pp. 29, 154, etc., pl. 25, figs. 1–10.*Loligo kubiensis* Ortmann, 1888, pp. 659, 665.

A species well characterized among all Japanese forms, except *L. aspera*, by its large tentacular suckers, the horny rings of which are devoid of teeth.

*Distribution*.—Inland Sea (Hoyle); Bay of Kobe, Settsu (type locality, Hoyle); Onomichi, Bingo (!); Nagasaki, Hizen (!); Mai-zuru, Tango (Ortmann).

*Material Examined.*—

No. Sp.	Locality.	Sex.	Collectors.	Where deposited.	Author's Register.
2	Onomichi, Bingo.....	♂ ♀	Jordan and Snyder	L.S.J.U., Cat. 2,031	365
2	Nagasaki, Hizen.....	♀	Jordan and Snyder	L.S.J.U., Cat. 2,032	366

***Loligo bleekeri*** Keferstein, 1866.

- Loligo Bleekeri* Keferstein, 1866, p. 1402, pl. 122, figs. 9, 10; pl. 127, fig. 14.  
*Loligo Bleekeri* Tryon, 1879, p. 149, pl. 57, figs. 185, 186.  
*Loligo Bleekeri* Brock, 1882, p. 604.  
*Loligo Bleekeri* Appellöf, 1886, p. 31, pl. 1, figs. 7-10.  
*Loligo bleekeri* Hoyle, 1886, pp. 30, 158, etc.  
*Loligo bleekeri* Ortmann, 1888, pp. 664, 665 (mere note).  
*Loligo bleekeri* Joubin, 1894, p. 56.  
*Loligo bleekeri* Wülker, 1910, pp. 10, 36, etc., pl. 4, fig. 30 (digestive system).

*Distribution.*—Aburatsubo, Sagami (Wülker); Nagasaki, Hizen (Appellöf). Amboina (Joubin).

***Loligo sumatrensis*** d'Orbigny, 1839.

- Loligo sumatrensis* d'Orbigny, in d'Orbigny and Férussac, 1839, p. 317; Calmars, pl. 13, figs. 1-3 (*vide* Hoyle).  
*Loligo sumatrensis* d'Orbigny, 1845, p. 349.  
*Teuthis sumatrensis* Gray, 1849, p. 77.  
*Loligo Sumatrensis* Tryon, 1879, p. 145, pl. 58, figs. 190, 191 (after d'Orb.).  
*Loligo sumatrensis* ? Appellöf, 1886, p. 32, pl. 1, fig. 11; pl. 3, figs. 11-15.  
*Loligo sumatrensis* Ortmann, 1888, p. 664 (merely listed).

*Distribution.*—Nagasaki, Hizen (Appellöf). Sumatra (type locality, d'Orbigny).

***Loligo japonica*** Steenstrup, 1885.

- Loligo japonica* Steenstrup, MS., in Hoyle, 1885*b*, p. 187.  
*Loligo japonica* Steenstrup, MS., in Hoyle, 1885*d*, p. 290.  
*Loligo japonica* Hoyle, 1886, pp. 30, 157, etc., pl. 24, figs. 7-15.  
*Loligo japonica* Ortmann, 1888, p. 663.

The nearest ally of this distinct little species is the next following and it now appears quite likely that the two are identical.

*Distribution.*—Yokohama (Hoyle); Aburatsubo, Sagami (Wülker).

***Loligo tetradynamia*** Ortmann, 1888.

- Loligo tetradynamia* Ortmann, 1888, p. 659, pl. 23, figs. 4*a*-4*k*; pl. 25, fig. 1.

This small and curious species, although admittedly showing close affinity to *L. japonica*, was differentiated by Ortmann on the following grounds:

1. The suckers of the lateral arms are very much larger than those of the dorsal and ventral pairs, a condition prevailing equally in both sexes.
2. There are no suckers upon the buccal membrane.
3. The arms of the third pair do not possess a membranous keel.
4. The structure of the hectocotylus is different.

Viewed casually, these features appear sufficiently diagnostic. Nevertheless, an examination of the large series of specimens before me causes me to incline very strongly to the opinion that *L. tetradynamia* will eventually prove to be entirely synonymous with *L. japonica*, although the differences apparent in the descriptions of the hectocotylized arms and one or two other less important divergencies deter me at present from uniting them. In this regard a comparison of the respective type specimens with one another would certainly prove of the utmost service.

The present specimens appear to belong beyond dispute to *L. tetradynamia*, and yet in several particulars Ortmann's diagnosis is not quite sufficient to embrace them. The hectocotylus is as described by Ortmann. Likewise the suckers of the lateral arms are invariably of conspicuously greater size than those of the dorsal and ventral pairs. However, this statement is decidedly not true of both sexes in equal degree, since in all the males I have seen the suckers of the lateral arms are at least half again as large as those of a female of the same size. Other differences to be noted are that the horny rings of the larger tentacular suckers are toothed all round, not alone upon the distal border, with some 23-25 blunt teeth, and that the arms of the third pair are possessed of a decided keel.

Indeed, the females accord suspiciously well with the specimen of *japonica* taken by the Challenger Expedition in the Yokohama Market. The chief points of difference are that here the dorsal arms are distinctly keeled instead of rounded, as stated by Hoyle, and he makes no mention of the great disparity in the size of the suckers, although his phrase "and vary in size in accordance with the arms on which they are situated" may amount to the same thing. Comparison with his excellent figure distinctly fortifies the latter interpretation. Likewise the tentacles are compressed and angular rather than cylindrical, and I have discovered no suckers on the buccal membrane, though I do not regard this observation as proving their absence there. These items of difference, however, seem to be very minor, and were it not for Hoyle's careful description of the curious hectocotylized arm of a male in the Copenhagen Museum which he held to be conspecific with his type, there could be little hesitation in relegating *L. tetradynamia* to the synonymy.

*Distribution*.—Same, Mutsu (!); Bay of Tokio (type locality, Ortmann, etc. !); Okayama, Bizen (!); Kochi, Toza (Ortmann); Kawatana, Hizen (!).

*Material Examined.*—

No. Sp.	Locality.	Sex.	Collectors.	Where deposited.	Author's Register.
2	Same, Mutsu.....	♂	Jordan and Snyder	L.S.J.U., Cat. 2,033	369
5	Bay of Tokio.....	♂ ♀	E. S. Morse	Yale Univ. Mus., Cat. 9,640	367
1	Bay of Tokio.....	♀	E. S. Morse	S.S.B., coll., 2,404	368
14	Tokio.....	♂ ♀	Jordan and Snyder	L.S.J.U., Cat. 2,034	370
1	Okayama, Bizen.....	♂	Alan Owston	L.S.J.U., Cat. 2,086	393
7	Kawatana, Hizen.....	♂ ♀	Jordan and Snyder	L.S.J.U., Cat. 2,035	371

*Loligo aspera* Ortmann, 1888.

*Loligo aspera* Ortmann, 1888, p. 661, pl. 25, figs. 3a-3d.

This species is so far known only from Kochi, Toza, the type locality, and I am not aware that it has been observed since its original description by Ortmann.

Genus **SEPIOTEUTHIS** Blainville, 1825.

[*Sepioteuthis sinensis* d'Orbigny, 1839.]

*Sepioteuthis sinensis* d'Orbigny, in d'Orbigny and Férussac, 1839, p. 304.

*Sepioteuthis sinensis* d'Orbigny, 1845, p. 329.

*Sepioteuthis sinensis* Tryon, 1879, p. 154.

D'Orbigny applied this name to a squid said to be eaten by the Japanese. No specific characters have been given.

*Sepioteuthis lessoniana* Férussac, 1826. Pl. VI, figs. 3, 5.

*Sepioteuthis Lessoniana* Férussac in d'Orbigny, 1826, p. 155.

*Sepioteuthis Lessoniana* Lesson, 1830, p. 241, pl. 11.

*Sepioteuthis Lessoniana* d'Orbigny and Férussac, 1839, p. 302; *Sepiot.*, pl. 1; pl. 6, figs. 9-14 (*vide* Hoyle).

*Sepioteuthis Lessoniana* d'Orbigny, 1845, p. 326.

*Sepioteuthis Lessoniana* Gray, 1849, p. 80.

*Sepioteuthis Lessoniana* Keferstein, 1866, p. 1402, pl. 122, fig. 7.

*Sepioteuthis Lessoniana* Tryon, 1879, p. 152, pl. 62, fig. 212; pl. 64, fig. 213.

*Sepioteuthis lessoniana* Appellöf, 1886, p. 31.

*Sepioteuthis lessoniana* Hoyle, 1886, pp. 27, 151, etc.

*Sepioteuthis lessoniana* Ortmann, 1888, pp. 657, 665.

*Sepioteuthis lessoniana* Ortmann, 1891, p. 676.

*Sepioteuthis Lessoniana* Joubin, 1894, p. 39.

*Sepioteuthis Lessoniana* Joubin, 1898, p. 26.

*Sepioteuthis lessoniana* Hoyle, 1909, p. 265.

*Sepioteuthis lessoniana* Wülker, 1910, pp. 11, 28, 36, etc., pl. 3, fig. 28; pl. 4, figs. 29, 31.

Body elongate, massive, dorso-ventrally compressed; contour elongate ovoid, tapering rapidly to a blunt point behind. Mantle very

thick and heavy; its anterior margin free, produced forward to a rounded point in the nuchal region, and similarly, but to a much less degree, ventrally; broadly emarginate below the funnel. Fins large; attached along the entire length of the mantle, which they slightly exceed both in front and behind in the specimen furnishing the description (a ♂ from Wakanoura), though not in the others. Cartilaginous articulations as usual in the genus, large and very prominent.

Head of moderate size, squarish. Eyes large and prominent. In front of the orbit is a large pore; behind it the integument is raised into a very prominent crest, bilobate, curved, and somewhat excavated in front, with the "olfactory" pore sheltered just below its dorsal margin. Funnel very large, very wide at the base and tapering bluntly to a rounded extremity; aperture large and directed downward, with well-developed lips and valve; supported above by a fleshy bridle at the base of the funnel groove.

Arms of moderate length, stout, squarish, unequal; the order of length not constant, but in my best specimens 3, 4, 2, 1. All the arms are outwardly keeled and provided with a broad marginal membrane supported by numerous transverse fleshy processes having their origin between the bases of the sucker pedicels. The latter is best developed on the third pair and least on the ventral arms. The keel, however, attains its maximum on the ventral arms, where it is developed as a broad, thickened web ensheathing the base of the tentacles. These arms are also furnished with a second less prominent keel running down their inner margins. Suckers large, regularly alternating in two rows on all the arms; horny rings prominent, armed with about 18 to 22 stout acute, curved teeth.

The hectocotylyzation affects the left ventral arm of the male after the fashion usual in this genus and in *Loligo*. The first 19 pairs of suckers are normal; they then become much reduced, and after the 24th pair are supplanted by stout conical papillæ. On the first four or five papillæ the suckers persist, though in a very rudimentary way, but soon become entirely obsolete. The integument on and between the papillæ of the Wakanoura specimen is much folded and lobed, a condition perhaps due to the action of the preservative.

Tentacles rather short, laterally much compressed and keeled on both outer and inner margins. The outer keel becomes expanded to form a broad fleshy web along the distal portion of the club. The inner carina soon becomes obsolete and is succeeded by an abruptly



differentiated flattened area, where the integument is finely and irregularly plicate. Club large, comprising nearly half the length of the tentacle, and provided with a broad trabeculate marginal membrane similar to that of the sessile arms. Suckers in four rows, large near the middle, diminishing in size toward either end, distally becoming very minute, and showing the spoon-shaped arrangement at the tip described by Goodrich (1896, p. 6) and Hoyle (1904, p. 31) for related species; horny rings with 18-20 stout, acute, incurved teeth.

Buccal membrane seven-pointed, bearing from three to five minute suckers on each lappet. The suckers are pedunculate and have horny rings.

Gladius lanceolate; the lateral thickenings diverging from the thick midrib extend along the middle of the wings for the posterior two-thirds of their length (Pl. VI, fig. 5).

Color of preserved specimens brownish-buff, heavily reticulated above with purplish-black, lighter below, and with the ventral surfaces of the fins unmarked.

#### *Measurements.*

The more important measurements of two male specimens are given below:

	No. 36. mm.	No. 341. mm.
Length, total.....	360	400+
Length of mantle, dorsal.....	207	235
Width of mantle.....	70	75
Width across fins at widest point.....	165	156
Width of fin at widest point, ventral.....	50	48
Width of head.....	53	61
Length of dorsal arm.....	61	68
Length of second arm.....	76	84
Length of third arm.....	95	102
Length of ventral arm.....	90	95
Length of hectocotylized portion.....	26	24
Length of tentacle.....	127	158
Length of tentacle club.....	63	79
Diameter of largest sucker on third arm.....	4	4
Diameter of largest sucker on tentacle.....	5	6

*Distribution.*—Tsuruga, Echizen (!); Tokio (Ortmann); Misaki, Sagami (!); Aburatsubo, Sagami (Wülker); Wakanoura, Kii (!); Bay of Waka, Kii (!); Kagoshima, Satsuma (Ortmann); Nagasaki, Hizen (Appellöf, !); Fusan, Korea (!). Trincomalee (d'Orbigny);

Ceylon (Ortmann); Cape Fabre (d'Orbigny); Java (d'Orbigny, Keferstein); Ternate (Hoyle); Amboina (Joubin); New Guinea (d'Orbigny); Apia, Samoa (!); Kandava, Fiji (Hoyle); New Zealand (Gray).

As the original figures of d'Orbigny and Férussac have not been accessible to me, I have not referred the specimens in hand to this species without a certain amount of hesitation, and hence have thought it well to enter somewhat fully into the details of their description. Few of the species of *Sepioteuthis* have been as well characterized in the literature as they should be, but I have little doubt that the present material is at least identical with that from the same region which authors before me have identified as *S. lessoniana*. The species is said to attain a length of three feet, but the maximum dimension given by Hoyle in respect to the specimens taken by the "Challenger" is only 570 mm.

If correctly understood, this form would seem to have a surprising range in the tropical and subtropical waters of the Pacific, and possibly several other nominal species should be relegated to the synonymy.

*Material Examined.*—

No. Sp.	Locality.	Sex.	Collectors.	Where deposited.	Author's Register.
1	Tsuruga, Echizen.....	♀	Jordan and Snyder	L.S.J.U.; Cat. 2,041	35
3	Misaki, Sagami.....	juv.	Jordan and Snyder	L.S.J.U., Cat. 2,036	37
9	Misaki, Sagami.....	juv.	Jordan and Snyder	L.S.J.U., Cat. 2,037	40
4	Bay of Waka, Kii.....	juv.	Jordan and Snyder	L.S.J.U., Cat. 2,039	41
1	Wakanoura, Kii.....	♂	Jordan and Snyder	L.S.J.U., Cat. 2,038	36
4	Nagasaki, Hizen.....	juv.	Jordan and Snyder	L.S.J.U., Cat. 2,040	38
1	Fusan, Korea.....	♂	D. S. Jordan	L.S.J.U., Cat. 2,042	341
6	Fusan, Korea.....	♂ ♀	D. S. Jordan	L.S.J.U., Cat. 2,043	342
3	Apia, Samoa.....	♂ ♀	D. S. Jordan	L.S.J.U., Cat. 2,044	39

*Sepioteuthis sieboldi* Joubin, 1898.

*Sepioteuthis Sieboldi* Joubin, 1898, p. 27 (*vide* Hoyle).

I have not seen the description of this species.

*Distribution.*—Japan (Joubin). Waigeou (Joubin).

**Sepioteuthis brevis** Owen, 1881.

*Sepioteuthis brevis* Owen, 1881, p. 137, pl. 26, fig. 1.

*Sepioteuthis brevis* (= *lessoniana* ?) Wülker, 1910, pp. 11, 22.

At best a doubtful species.

*Distribution*.—Japan (Owen).

Family **IDIOSEPIIDÆ** Appellöf, 1898.

Genus **IDIOSEPIUS** Steenstrup, 1881.

**Idiosepius paradoxa** (Ortmann, 1888).

? *Idiosepius pygmæus* Steenstrup, 1881, p. 219, pl. 1, figs. 11–22.

*Microteuthis paradoxa* Ortmann, 1888, pp. 649, 665, pl. 22, fig. 4.

*Microteuthis paradoxa* Joubin, 1902, p. 105, fig. 15.

*Idiosepius pygmæus* Wülker, 1910, p. 22 (merely listed).

By Wülker this species is considered to be identical with *I. pygmæus* Steenstrup, and such may well prove to be the case.

*Distribution*.—Kadsiyama (type locality, Ortmann).

Family **SEPIOLIDÆ** Steenstrup, 1861.

Sub-family **SEPIOLINÆ** s. s.

Genus **INIOTEUTHIS** Verrill, 1881.

**Inioteuthis japonica** (Tilesius MS.?) Verrill, 1881. Pl. V, fig. 5.

? *Sepiola Japonica* d'Orbigny (from Tilesius MS.) in d'Orbigny and Férussac, 1839, p. 234, No. 3 (*vide* d'Orbigny).

? *Sepiola Japonica* d'Orbigny, 1845, p. 251.

? *Sepiola* ? *Japonica* Gray, 1849, p. 93.

? *Sepiola japonica* Steenstrup, 1857, pp. 93, 94.

? *Sepiola Japonica* Tryon, 1879, p. 157.

*Inioteuthis japonica* Verrill, 1881, p. 417, footnote.

*Inioteuthis japonica* Appellöf, 1886, p. 16.

*Inioteuthis japonica* Hoyle, 1886, pp. 17, 113, etc.

*Inioteuthis japonica* Ortmann, 1888, p. 647, pl. 21, fig. 6; pl. 22, fig. 2.

*Inioteuthis japonica* Joubin, 1897a, p. 101.

*Sepiola japonica* Joubin, 1902, p. 95, fig. 10.

*Inioteuthis japonica* Hoyle, 1904, p. 27.

*Inioteuthis japonica* Wülker, 1910, p. 10.

*Sepiola inioteuthis* Naef, 1912a, pp. 265, 266, 268.

The species *Sepiola japonica* was published by d'Orbigny from a manuscript letter of Tilesius and I cannot find that any specimens were seen by d'Orbigny himself. Gray (1849) copied his diagnosis from d'Orbigny, but expressed some doubt as to its proper reference to *Sepiola*. Then except for a brief mention in Tryon's "Manual" (1879) we find it otherwise unnoticed for over thirty years. Finally a small collection of squids obtained by Prof. E. S. Morse in the Bay of Tokio was sent by him to Prof. A. E. Verrill, then engaged with his report on "The Cephalopods of the Northeastern Coast." These specimens furnished the descriptions of two species which were accordingly published in the appendix of this report as a footnote (1881, p. 417), and the genus *Inioteuthis* was erected to receive them. The form now under consideration was expressly made the

type<sup>4</sup> and identified with the *Sepiola Japonica* of d'Orbigny, although upon exactly what grounds other than general probability does not seem to be entirely clear. A great many points yet remain to be cleared up, and, as I have been able through the kindness of Prof. Verrill himself to secure the use of the majority of his specimens, they have been made the basis of the more extended description of the species given herewith:

Body short and saccular; mantle in the male somewhat bell-shaped, widest in front, tapering rapidly to a rounded posterior extremity; in the adult female more rounded and cylindrical, less tapering, and relatively much more plump. Nuchal commissure rather wide, but considerably narrower than in *Euprymna morsei*. Mantle margin usually, but not always, more or less emarginate beneath, permitting the siphon a greater freedom of movement.

Fins thin, small, subcircular, forming a lobe in front; attachment narrow, considerably above the median horizontal plane of the body; position with regard to the mantle almost median in the adult, but in the young placed much further back.

Head oblong, flattened above; width inclusive of the eyes about twice the length. Funnel long, tapering, rather slender. Locking apparatus comprising an oblong groove on either side of the base of the funnel and folds to correspond on the inner surface of the mantle. The grooves are provided with a thickened reflexed margin. The folds are simple narrow ridges, much longer than the grooves.

Eyes of moderate size; openings small. "Olfactory organ" situated considerably below and behind the lid opening.

Arms short, fleshy, but fairly slender; the first pair the shortest and smallest, the rest subequal; third pair obscurely carinate, stouter and somewhat longer than the others. A poorly developed web connects the arms at the base, but is obsolete or wanting between the ventral pair. Suckers in two alternating rows; in the female very minute and alike on all the arms; somewhat modified in the male. Left dorsal arm of the male very conspicuously hectocotylized; at its extreme base appear one or two very minute and rudimentary suckers, these immediately succeeded by a huge ridge-like swelling, irregularly oval in shape and somewhat suggestive of the concha of the human ear; this curious organ extends about half way up the arm and is apparently formed by the fusion of exceedingly modified and obscured sucker pedicels, though it bears no suckers. The figure of the structure given by Ortmann is recognizable, but scarcely

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<sup>4</sup>The second species, *I. morsei*, has since become the type of Steenstrup's genus *Euprymna*.

more. The distal half of the arm is sucker bearing, but on the specimen in hand only the pedicels remain. The right dorsal arm is essentially like that of the ♀ except that the suckers along its central portion are very much larger than the rest and hence fewer in number. The same peculiarity is true of the outer row of suckers on the second pair of arms of the ♂ and to a much less degree of the ventral arms. The suckers of the third-arm pair are very minute and relatively very widely spaced.

Individual suckers of the sessile arms nearly spherical, with very small apertures and smooth horny rings. They break off with such ease that few of my specimens retain an average of more than two or three on each arm.

Tentacles slender, as long as the body, but when bent back not extending beyond the fins; tentacular club but little thickened, with a thin membrane along its inner margin, its inner surface villous; a microscopic examination shows the velvety appearance to be due to the exceeding minuteness of the suckers which clothe it; the latter long pediceled and closely placed in about eight rows. Individual suckers bell-shaped, the wide openings surrounded by a papillary area, outside of which is a thin, broad, outwardly flaring, striate membrane; horny rings well developed, seemingly armed with twenty or more distinct acute teeth, but it is not outside the range of possibility that the apparent teeth may be merely very large papillæ or chitinous projections from the papillary border.

Beak and radula not examined. Gladius none.

Color when living not observed; in alcohol a pale yellowish-brown, the chromatophores appearing as bluish-black spots, quite small and distinct on the mantle, larger and more run together on the head.

*Measurements.*

Sex.....	Cotypes.			
	♂	♂	♀	♀
Number in author's register.....	[112]	[111]	[391]	[392]
Length total (excluding tentacles)....	40	32	35	31
Length of mantle, dorsal.....	19	16	17.5	15
Width of body.....	12	12	13	10.5
Width of nuchal commissure.....	5.5	5	6	5
Width across fins.....	23	.....	25	24
Length of fin, extreme.....	10	.....	9.5	9
Length of fin at point of attachment.	6.5	5.5	6	5.5
Length of dorsal arm (left side).....	16	9	10.5	10
Length of second arm.....	18	14	12	12
Length of third arm.....	18	14	13	12
Length of ventral arm.....	13	13.5	12	10
Length of tentacle.....	27	23	26	20

*Type*.—Cat. No. 9,639 (part), Yale University Museum; a male. Cotypes of same sex in Yale University Museum and the author's collection.

*Type Locality*.—Bay of Yeddo (Tokio), Japan; Edward S. Morse.

*Distribution*.—Matsushima, Rikuzen (!); Bay of Tokio (!); Enoshima, Sagami (!); Aburatsubo, Sagami (Wülker); Nagasaki, Hizen (Joubin).

*Specimens Examined*.—

No. Sp.	Locality.	Sex.	Collectors.	Where deposited.	Author's Register.
2	Bay of Tokio.....	♂	E. S. Morse	Yale Univ. Mus., Cat. 9,639 (cotypes)	111
1	Bay of Tokio.....	♂	E. S. Morse	S.S.B., (cotype)	112
5	Bay of Tokio.....	♀	E. S. Morse	Yale Univ. Mus., Cat. 9,639a	390
1	Bay of Tokio.....	♀	E. S. Morse	S.S.B.,	391
1	Matsushima, Rikuzen...	♀		L.S.J.U., Cat. 2,019	392
1	Enoshima, Sagami.....	♀	A. Owston	L.S.J.U., Cat. 2,020	389

Since the establishment of the genus and the elimination of *Euprymna morsei*, *Iniotheuthis* has been enriched by the addition of but one other species, the *I. maculosa* Goodrich 1896. In the meanwhile the actual status of the group has been the occasion of considerable discussion. Unquestionably, the most important known difference separating *Iniotheuthis* from *Sepiola* is the absence of a gladius in the former, the generic significance of which feature in a case such as the present is certainly not yet fully established.

*I. maculosa* does not seem to differ very strikingly from the Japanese species and further information regarding it would be very useful. It has been reported from the Andaman Islands, Ceylon, and the Persian Gulf.

Genus **EUPRYMNA** Steenstrup, 1887.

**Euprymna morsei** (Verrill, 1881) Steenstrup, 1887. Pl. VI, figs. 1, 2.

*Iniotheuthis Morsei* Verrill, 1881, p. 417, footnote.

? *Sepiola bursa* Pfeffer, 1884, p. 6, fig. 6.

*Iniotheuthis Morsei* Appellöf, 1886, p. 15, pl. 2, figs. 15, 16; pl. 3, figs. 16, 19, 20, 23.

*Iniotheuthis morsei* Hoyle, 1886, pp. 17, 112, etc., pl. 14, figs. 1-9.

*Euprymna Morsei* Steenstrup, 1887, p. 66 [20].

- Euprymna Morsei* Steenstrup, 1887a, p. 89 [43].  
*Inioteuthis morsei* Ortmann, 1888, pp. 647, 665, pl. 21, fig. 7; pl. 22, fig. 3.  
*Inioteuthis Morsei* Joubin, 1897a, p. 101 (dimensions, *vide* Hoyle).  
*Inioteuthis Morsei* Joubin, 1902, p. 97, figs. 11, 12.  
*Euprymna morsei* Hoyle, 1904, p. 26.  
*Euprymna morsei* Hoyle, 1904a, p. 198.  
*Euprymna morsei* Hoyle, 1905, p. 981.  
 not *Euprymna morsei* Berry, 1909, p. 418 (locality record).  
*Euprymna morsei* Wülker, 1910, pp. 9, etc., pl. 1, fig. 9; pl. 3, figs. 23, 24; pl. 4, fig. 40 (anatomy).  
*Euprymna morsei* Naef, 1912, p. 247.

<sup>5</sup> Animal small, sepioliform; body short, thick, rounded, the lateral diameter on the average equal to about three-fourths of the length. Fins large, semicircular, attached very obliquely in advance of the middle of the body; broadest posteriorly; anterior lobe conspicuous and abruptly notched at its inner margin so that the attached portion of the fin comprises but about the posterior two-thirds of the total length. Mantle margin projecting well forward ventrally, but with a deep, notch-like emargination just below and encompassing the funnel; united dorsally with the head by means of a very wide commissure, so that the opening of the mantle cavity attains only to a point just back of, and superior to, the eye opening on either side.

Head almost as broad as the body, the length somewhat exceeded by the width; flattened above; beneath slightly excavated for the reception of the funnel. Eyes very large and prominent, somewhat swollen. Funnel large, very elongate, but in the best preserved specimens not nearly reaching to the margin of the web between the ventral arms; tip with three heavy longitudinal ridges<sup>6</sup> on its interior surface, just back of which on the dorsal wall is a minute triangular valve; general surface of interior transversely ridged. Funnel organ posterior in position, large, tripartite, comprising a broad triangular-hepatiform median pad on the dorsal wall and a pair

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<sup>5</sup> Verrill's original diagnosis (1881, p. 417, footnote) is as follows:

"*Inioteuthis Morsei* V., sp. nov. This is easily distinguished from the preceding [*I. japonica*] by the presence of four crowded rows of suckers on all the arms; the suckers are attached by slender pedicles, which arise from the top of prominent, thickened, basal stems. The tentacular clubs are well developed, with exceedingly numerous, very minute suckers, in more than sixteen rows. Fins large, situated in advance of the middle of the body. Dorsal and ventral arms about equal; two lateral pairs longer, the third pair slightly longer than the second. Mantle edge, beneath, with a large emargination; dorsal commissure broad.

"No males of this species are in the collection; therefore I refer it to this genus only provisionally. It has no pen."

<sup>6</sup> I am inclined to consider these ridges a physiological modification attendant upon the conditions of preservation of the specimen furnishing the description.

of large elongate-pyriform cushions on the ventral wall; a narrow membranous ridge running down the centre of the median pad terminates anteriorly in a minute slender papilla.

Arms rather short, but the shortest ones usually at least as long as the mantle, the others somewhat longer; unequal, the order of relative length usually about 2, 3, 4 = 1<sup>7</sup>; dorsal (outer) margin of ventral arms carinate, the others rounded; outer surfaces smooth. Umbrella lacking or at best rudimentary between the dorsal arms, better developed between the dorsal and second arms and between these and the third pair; between the third and fourth pairs it extends for over one-quarter of their length as a broad web ensheathing the base of the tentacles, becoming again much reduced or even obsolete between the ventral arms. Suckers on all the arms closely crowded in four rows, except at the extreme base where they appear in two to three rows; obliquely poised on stout conical pedicels so that they are easily rubbed off, leaving the stumpy pedicels intact; nearly spherical; apertures small, with smooth horny rings.

The above remarks I believe to be equally applicable to either sex, but in the detailed arrangement and appearance of the suckers a number of fairly conspicuous differences become evident. In the ♀ the suckers at corresponding parts of all the arms are subequal and exceedingly minute, their diameter little greater than that of the thickened bases of the pedicels. In the ♂, left ventral arm conspicuously hectocotylized; distinctly thicker and perhaps a little shorter than its mate; all the suckers nearly as small as in the ♀, the first two or three pairs in two to three rows, the remainder in four; about where the four-rowed condition commences, two components of the outermost (ventral) row become modified as a pair of elongate suckerless papillæ; subsequent to this point ensue about six quartets of normal suckers reaching somewhat less than half way up the arm. Here the suckers of the two ventral rows are succeeded by a single series of much enlarged, compressed, transversely elongate, tightly palisaded papillæ of a very characteristic appearance, bearing the merest rudiments of suckers at their tips; these rudiments have mouth-like apertures, but do not have the appearance of mere lips as figured by Hoyle for *E. stenodactyla*, since close examination reveals the presence of well-developed though minute horny rings, their margins minutely but distinctly dentate with a number of acutely

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<sup>7</sup> Variations from this formula occur frequently in my material, but in this instance the majority of them seem due merely to poor preservation.



pointed triangular teeth. The number of these papillæ is about thirty, the largest occurring in the neighborhood of the tenth, thence gradually diminishing in size toward the tip. The suckers of the dorsal rows maintain their arrangement in two series and there are about three more pairs of unmodified suckers than in the ventral row, but at this point they, too, become affected, their pedicels much swollen and puffed out, and the suckers themselves relatively much reduced, though not to quite so great a degree as in the ventral row. The horny ring from one of these also shows minute teeth. The right dorsal arm is longer, more slender, and more closely approximates the condition found in the ♀, but most of the suckers from the present specimens have been lost through abrasion, so there may have been minute differences now impossible to observe. On the second arms most, if not all, of the suckers of both the two outermost rows are two to three times as large as those of the two median rows, except near the tip, where all are again subequal. My specimens do not warrant the assertion that a similar condition prevails on the third pair, but it certainly reappears on the ventral arms and is here again nearly as conspicuous as on those of the second pair. A large sucker taken from the latter is rotund, its base somewhat heart-shaped; horny rings deep, smooth, but with a lateral indentation on each margin, above which a large, thin, hood-shaped expansion obstructs part of the aperture and destroys its otherwise nearly circular outline.

Tentacles stout, elastic, cylindrical; inner surface slightly flattened; half as long again as the body and more. Clubs little expanded, keeled, tips recurved; inner face rounded, everywhere armed with exceedingly numerous and minute, long-stalked suckers, giving it a finely villous appearance.

Buccal membrane fleshy, pointed, rugose within.

Radula not examined.

Gladius wanting.

Color in alcohol a light brownish-buff; heavily maculated both above and below with numerous large dark slate-colored chromatophores, which are least numerous on the inner surfaces of the arms and the lower aspect of the fins. On the under side of the latter over the area adjacent to the base of attachment they are absent.

*Measurements.*

Number in author's register.....[291]	[105] Cotype.	[288] Cotype.	[285]
Sex..... ♀	♀	♀	♀
Length, total.....140	64	38	.....
Tip of body to base of dorsal arms..... 58	28	21	.....
Tip of body to tip of dorsal arms.....101	43	34	.....
Length of mantle, dorsal..... 40	20	15	30
Width of mantle..... 26	14	13	.....
Width of dorsal commissure..... 14	8	8	.....
Width across fins..... 58	29	23	43
Length of fins, total..... 22	10	9	.....
Length of fins along plane of attachment..... 14	7	7	.....
Length of head..... 19	7	5	.....
Width of head..... 23	13	11	.....
Length of right dorsal arm <sup>s</sup> ..... 36	12	12	.....
Length of left dorsal arm <sup>s</sup> ..... 35	12	12	.....
Length of second arm <sup>s</sup> ..... 46	14+	14	40
Length of third arm <sup>s</sup> ..... 39	15	13	.....
Length of ventral arm <sup>s</sup> ..... 36	12	12	.....
Length of tentacle..... 80	36	19	101
Length of tentacle club..... 16	5	3.5	.....
Length of funnel..... 24	.....	.....	.....
Number in author's register..... [290]	[292]	[294]	[285]
Sex..... ♂	♂	♂	♂
Length, total.....119	95	113	.....
Tip of body to base of dorsal arms..... 43	31	48	.....
Tip of body to tip of dorsal arms..... 84	63	85	.....
Length of mantle, dorsal..... 32	21	32	16
Width of mantle..... 20	15	24	.....
Width of dorsal commissure..... 12	11	16	.....
Width across fins..... 40	28	43+	28
Length of fins, total..... 16	11	.....	.....
Length of fins along plane of attachment..... 10	8	12	.....
Length of head..... 12	10	16	.....
Width of head..... 17	14	19	.....
Length of right dorsal arm <sup>s</sup> ..... 37	26	25+	.....
Length of left dorsal arm <sup>s</sup> ..... 25	24	29+	.....
Length of second arm <sup>s</sup> ..... 40	34	42	15.5
Length of third arm <sup>s</sup> ..... 33+	32	.....	.....
Length of ventral arm <sup>s</sup> ..... 36	27	35	.....
Length of tentacle..... 74	65	75	19
Length of tentacle club..... 11	10	10	.....
Length of funnel..... 19	19	22	.....

<sup>s</sup> Measured along inner face from outer base of buccal membrane.

*Type*.—Cat. 9,638, Yale University Museum, a female [S. S. B. No. 105]. Cotypes in Yale University Museum and in Cat. No. 2,402 of the author's collection, also a female.

*Type Locality*.—Bay of Yeddo (Tokio), Japan; Edward S. Morse; 3 ♀.

*Distribution*.—Bay of Tokio (Verrill,!); off Misaki, Sagami (Wülker); off Dzushi, Sagami (Wülker); Wakanoura, Kii (!); Bay of Waka, Kii (!); off Kobe, Settsu (Hoyle); Onomichi, Bingo (!); Kagoshima, Satsuma (Ortmann); Kadsiyama (Ortmann); Nagasaki, Hizen (Appellöf, Joubin,!); Takao, Formosa (!). Hong Kong, China (!); Gulf of Manaar (Hoyle); Andaman Islands (Goodrich); Maldive Archipelago (Hoyle).

*Specimens Examined*.—

No. Sp.	Locality.	Sex.	Collector.	Where deposited.	Author's Register.
1	Bay of Tokio.....	♀	E. S. Morse	Yale Univ. Mus., Cat. 9,638 (cotype)	105
1	Bay of Tokio.....	♀	E. S. Morse	S.S.B., Cat. 2,402 (cotype)	288
1	Wakanoura, Kii.....	♀	Jordan and Snyder	L.S.J.U., Cat. 2,022	293
3	Bay of Waka, Kii.....	♀ ♂	Jordan and Snyder	L.S.J.U., Cat. 2,023	294
3	Onomichi, Bingo.....	♀ ♂	Jordan and Snyder	L.S.J.U., Cat. 2,021	292
4	Nagasaki, Hizen.....	♀ ♂	Jordan and Snyder	L.S.J.U., Cat. 2,024	289
1	Japan.....	♀	?	L.S.J.U., Cat. 2,025	291
3	Takao, Formosa.....	♀ ♂	Hans Sauter	L.S.J.U., Cat. 2,026	290
5	Hong Kong, China.....	♀ ♂	W.H.A. Putnam, 1861	Mus.Comp. Zool., Cat. 1,571	283
1	Hong Kong, China.....	♀	W.H.A. Putnam	Mus.Comp. Zool., Cat. 3,446	284
2	Hong Kong, China.....	♀ ♂	W.H.A. Putnam	Mus.Comp. Zool., Cat. 1,537	285

The material at my disposal referable to this species has been so unusual both in quantity and character, including even the

original type specimens of Verrill, that despite the juvenility of the latter and the admittedly unfavorable preservation of the remainder I have thought it well to redescribe the species throughout as carefully and completely as the material would allow. One of the types is likewise figured on Plate VI. Some of the nearly allied species are most puzzlingly close, but it is hoped that the data here given will prove sufficient to prevent its confusion with any of them. It must be confessed, however, that I have been unable to select any characters or combinations of characters which I am certain will suffice to distinguish a series consisting of females alone from any other species of the genus. The males appear to be constantly characterized by the large number of modified suckers on the hectocotylized arm, coupled with the fact that the suckers of *both* the outer rows of the second, third, and fourth arms undergo enlargement, a character exceedingly conspicuous on the second arms at least and in well-preserved material probably on all.

Good descriptions have already been given by Appellöf (1886), Hoyle (1886), Ortmann (1888), and of the anatomy by Wülker (1910). Verrill's types are therefore made the basis of the above notes, with the exception of those portions relating to the ♂, of which he had no specimens. However, his specimens do not differ from the various larger females seen by me in any essential particulars except their dimensions.

This is the commonest Japanese Sepiolid and has been obtained by so many collectors that it must be a species of considerable abundance. Specimens from Formosa do not seem different in any way, nor have I been able to separately identify the large series of individuals from Hong Kong in the Museum of Comparative Zoology. The latter is also the type locality for Pfeffer's *Sepiola bursa*, and should not specimens in better preservation prove otherwise, there can be little doubt that this name is a complete synonym of *E. morsei*.

Genus **STOLOTEUTHIS** Verrill, 1881.

**Stoloteuthis nipponensis** Berry, 1911. Pl. V, figs. 1-4.

*Stoloteuthis nipponensis* Berry, 1911, p. 39, fig.

*Sepiolina nipponensis* Naef, 1912, p. 248.

Body small, compact, short, plump, sepioliform, rounded behind. Mantle attached to the head dorsally by a rather narrow commissure (4.5 mm.); free below and produced forward beneath the head, its edge sinuous and slightly emarginate in front, so as to expose the extreme tip of the funnel, otherwise entirely hidden. Fins large, semicordate, the forward lobe extending from the anterior base of

attachment as far as the mantle margin; posterior lobe scarcely developed; nearly median in position, the plane of attachment nearly level with the dorsal surface of the mantle.

Head very large, as broad as the body, flattened above, excavated beneath. Eyes large with rather large openings; the right eyelid appears to be free all round, the left eye has only the lower lid free. Funnel rather small, flexed upward so as to lie closely in the excavation formed by the hollowed under surface of the head. A slight curved longitudinal groove with a raised and reflexed edge, situated on either side of the funnel quite far back, articulates with a corresponding ridge on the inner surface of the mantle; the ridge similarly curved, rather heavy, and notably longer than the groove. "Olfactory organ" situated on the same level with the lower eyelid and just behind it.

Arms stout, thick, fleshy, and rather short, the order of length 2, 1, 3, 4, only the ventral arms noticeably shorter than the others; each with two rows of spherical short-pediceled suckers extending for their entire length. Both dorsal arms hectocotyized; squarish, prominently keeled above, unequal, the right slightly the larger; much swollen; suckers very small, even at the base of the arms, whence they gradually diminish in size toward the tip, the two rows very regularly alternating; inner surface of each arm curiously striate with numerous fine transverse corrugations arranged more or less in bands to correspond with the bases of the sucker pedicels. Suckers of the second pair of arms slightly larger, but still quite small, excepting some five pairs along the middle of the arm which are conspicuously larger than the rest; third pair similar in structure to the second pair; ventral arms shorter and more slender than the others, their suckers mainly lost in the specimen examined. The pedicels of all the suckers, especially the enlarged ones, are very brittle and delicate. Openings of suckers very small; horny rings smooth. Arms connected at the extreme base by a poorly developed web or umbrella which is totally lacking between the ventral pair; dorsal arms laterally angled and with a dorsal keel; in the second pair angles and keel become obsolete, but reappear again in the third pair; ventral arms keeled along the outer side.

Tentacles stout and fleshy; about as long as the mantle; the club furnished with a membranous keel, but otherwise not exceeding the stalk in diameter; suckers extremely minute, subequal, irregularly arranged in at least 12 (perhaps as many as 16) rows, giving the club a velvety appearance; peduncles slender; the horny rings

under the high power *seem* to be smooth, but the material examined is imperfectly stained.

Color in life unknown; in alcohol a pale brown, suffused here and there with blackish-purple. Chromatophores numerous, appearing as dark dots. As in the other species of the genus, the ventral surface of the mantle is marked by a large shield-shaped patch, over which the chromatophores are exceedingly fine, numerous, and evenly distributed; the patch is bordered by a rather indistinct, slaty-blue margin.

Beak and radula not examined. Gladius absent.

*Type*.—Cat. No. 2,027 (Invertebrate Series) of the Stanford University collections; a male. The type is unique. [S. S. B. No. 32.]

*Type Locality*.—Suruga Bay, Japan.

*Measurements*.—The chief measurements of the type are as follows:

	mm.
Total length exclusive of tentacles.....	38.5
Medio-dorsal length of mantle.....	17
Medio-ventral length of mantle.....	20
Width of body.....	13
Width across fins.....	24
Length of fin, total.....	13
Length of fin at plane of attachment.....	9
Width of nuchal commissure.....	4.5
Width of head.....	14
Length of head.....	9
Length of dorsal arm.....	11
Length of second arm.....	12
Length of third arm.....	10.5
Length of ventral arm (measured from inner base).....	10
Length of tentacle.....	20

*S. nipponensis* appears to be very different from either of the only two species of the genus heretofore described, although sharing with them the curious combination of characters upon which the group was founded. The generic type—*S. leucoptera* Verrill, from the North Atlantic—differs in the more complete webbing of the arms, their relative shortness, the more anterior position of the fins, hectocotylization (though affecting the same arms), and other details. It is also stated to have the eyelids free all round, but from the appearance of the present specimen this should possibly be regarded as a physiological condition, rather than a permanent feature as in the oegopsid decapods.

The other Pacific form—*S. iris* Berry, from the Hawaiian Islands—has a totally different aspect and stands quite alone in the relative

magnitude of its head and fins and the great width of the nuchal commissure. If the type is adult, it is also a much smaller species than *S. nipponensis*.

Naef (1912) has recently made *S. nipponensis* the type of a new genus *Sepiolina*.

Sub-family ROSSIINÆ.

Genus **ROSSIA** Owen, 1834.

**Rossia** sp.

Dr. Heath has shown me egg capsules containing late embryonic stages of some species of *Rossia*. The animals were far enough advanced to exhibit clearly the distinctive characters of the genus. They were taken off the northwestern coast of Honshu.

Genus **PROMACHOTEUTHIS** Hoyle, 1885.

**Promachoteuthis megaptera** Hoyle, 1885.

*Promachoteuthis megaptera* Hoyle, 1885, p. 273, fig. 109.

*Promachoteuthis megaptera* Hoyle, 1885b, p. 182.

*Promachoteuthis megaptera* Hoyle, 1885d, p. 284.

*Promachoteuthis megaptera* Hoyle, 1886, pp. 19, 120, etc., text fig. 3, pl. 14, figs. 10-14.

*Promachoteuthis megaptera* Joubin, 1902, p. 109, fig. 17.

*Distribution*.—1,875 fathoms, southeast of Nosima (type locality—Hoyle).

Family **SEPIIDÆ** Steenstrup, 1861.

Genus **SEPIA** Linné, 1758.

The tremendous development of the genus *Sepia*, both in species and number of individuals, is the most conspicuous feature of the cephalopod fauna of Japan, as it is likewise in the waters of the Indo-Malayan Archipelago. It is therefore not surprising to find that no less than eighteen names have at one time or another been applied to Japanese forms. These are as follows:

*Sepia aculeata*.

*Sepia sinensis*.<sup>9</sup>

*Sepia chrysophthalmos*.<sup>10</sup>

*Sepia myrsus*.<sup>11</sup>

*Sepia andreana*.

*Sepia esculenta*.

*Sepia elliptica*.

*Sepia kubiensis*.

*Sepia andreanoides*.

*Sepia peterseni*.

*Sepia tullbergi* [= *Metasepia*].

*Sepia tokioensis*.

*Sepia hoylei*.

*Sepia torosa*.

*Sepia hercules*.

*Sepia lorigera*.

*Sepia misakiensis*.

*Sepia appelloffi*.

<sup>9</sup> *Sepia sinensis* d'Orbigny, 1839, united by Gray with *S. inermis* (van Hasselt), is a name applied by d'Orbigny to a squid described in an article in the *Encyclopédie japonaise*. Although Tryon follows Gray, it seems doubtful if the species is in any way recognizable.

<sup>10</sup> *Sepia chrysophthalmos* Tilesius is a minute animal referred by d'Orbigny (1839, p. 324, *Loligopsis*, pl. 1, figs. 2-4, *fide* Hoyle) to *Loligopsis*, but probably impossible of determination.

<sup>11</sup> *Sepia myrsus* Gray (1849, p. 108) has been doubtfully listed in the Japanese fauna by Hoyle (1886, p. 219), but I know of no other reference to its actual occurrence there.

This list is somewhat reduced by the elimination of doubtful names, but even then contains many species which are not always easy to distinguish from one another and sometimes offer problems of great difficulty. The entire group is much in need of a painstaking and thorough revision at the hands of someone having access to a wealth of carefully preserved material, and when this time comes it is possible that several of the nominal species may be reduced to the rank of synonyms. A good many specimens have been available to the present writer, but the series have usually been too incomplete or, in the case of numerous market specimens, too poorly preserved to render accurate determination easy, much less afford ground for any important generalizations.

The majority of Japanese species belong to a rather well-defined group of narrow-shelled forms referred to by Wülker as the "*andreana*-Gruppe" and here for the sake of convenience recognized as a subgenus or section, to denominate which the term *Doratosepion* de Rochebrune has been rehabilitated. An excellent discussion of these forms together with a detailed key to the same has been given by Wülker (1910, pp. 17-20).

***Sepia aculeata*** Van Hasselt MS., 1834.

*Sepia aculeata* Van Hasselt MS., in d'Orbigny and Férussac, 1834, p. 287, pls. 5, 25 (*vide* Wülker).

*Sepia aculeata* d'Orbigny, 1845, p. 296.

*Sepia aculeata* Gray, 1849, p. 105.

*Sepia aculeata* Steenstrup, 1875, p. 473, pl. 2, fig. 4.

*Sepia aculeata* Tryon, 1879, p. 195, pl. 90, fig. 415; pl. 91, figs. 416, 417 (after d'Orbigny).

*Acanthosepion Hasselti* de Rochebrune, 1884, p. 101.

*Sepia aculeata* Joubin, 1898, p. 25.

*Sepia aculeata* Wülker, 1910, p. 11.

A large ♂ specimen of this species having a dorsal mantle length of 21 cm. is entered as Cat. No. 2,045 in the Stanford University Invertebrate Series [S. S. B. No. 343]. It was obtained by Messrs. Jordan and Snyder at Tsuruga, Echizen. The locular index of the gladius of this specimen is 13.3.

*Distribution*.—Near Misaki, Sagami (Wülker); Tsuruga, Echizen (!). Java (d'Orbigny); Indian Ocean (Gray).

***Sepia esculenta*** Hoyle, 1885.

*Sepia esculenta* Hoyle, 1885*b*, p. 188.

*Sepia esculenta* Hoyle, 1885*d*, p. 291.

*Sepia esculenta* Appellöf, 1886, p. 28, pl. 3, figs. 1-6.

*Sepia esculenta* Hoyle, 1886, pp. 129, etc., pl. 17, figs. 1-5; pl. 18, figs. 1-6.

*Sepia esculenta* Ortmann, 1888, pp. 649, 665.

*Sepia esculenta* Pilsbry, 1894, p. 144.

*Sepia esculenta* Hedley, 1906, p. 463.

A single ♀, entered as No. 2,046 of the Invertebrate Series,



Stanford University collections [S. S. B. No. 360], was obtained at Tokio by Jordan and Snyder. It much resembles the preceding species, but seems clearly referable to *S. esculenta* since it "lacks the suckers on the buccal membrane and also the callosity of the inner cone." Despite these differences, the two forms are very nearly allied.

*Distribution*.—Tokio (Ortmann, !); Yokohama Market (type locality, Hoyle); Nagasaki, Hizen (Appellöf). Queensland, Australia (Hedley).

***Sepia Hercules*** Pilsbry, 1894.

*Sepia hercules* Pilsbry, 1894, p. 144.

*Sepia hercules* Pilsbry, 1895, p. 2, pl. 1, fig. 2.

*Sepia hercules* Wülker, 1910, pp. 11, 22, 24 (mere note).

*Distribution*.—Japan (Pilsbry); Loo Choo Islands (Pilsbry).

***Sepia elliptica*** Hoyle, 1885.

*Sepia elliptica* Hoyle, 1885*b*, p. 189.

*Sepia elliptica* Hoyle, 1885*d*, p. 293.

*Sepia elliptica* Hoyle, 1886, pp. 22, 131, etc., pl. 19, figs. 14–24.

*Sepia elliptica*, Wülker, 1910, pp. 11, 23.

*Distribution*.—Near Misaki, Sagami (Wülker). Arafura Sea, south of Papua (type locality, Hoyle).

***Sepia hoylei*** Ortmann, 1888.

*Sepia hoylei* Ortmann, 1888, p. 650, pl. 22, fig. 5; pl. 23, fig. 1.

*Sepia elliptica* (pars ?) Wülker, 1910, pp. 11, 22.

Wülker has suggested that this species may be identical with *S. elliptica* and infers that Ortmann may have been mistaken in the most important diagnostic character—the presence of teeth on the horny rings of the sessile arm suckers. I can, however, confirm Ortmann's observation. Suckers of a specimen from Nagasaki show about 35 small, short, broadly conical teeth, their tips squarish (or broken ?), developed with fair evenness all around. In all other respects also this material agrees well with the description of *S. hoylei*, but indicates that this form is at best so weakly differentiated from *S. elliptica* that the conclusion attained by Wülker may yet prove to be correct.

A specimen before me from Wakanoura is young and too poorly preserved for certain identification, but the gladius agrees well with the Nagasaki specimens.

*Material Examined*.—

No. Sp.	Locality.	Collector.	Where deposited.	Author's Register.
4	Nagasaki, Hizen.....	Jordan and Snyder	L.S.J.U., Cat. 2,047	356
? 1	Wakanoura, Kii.....	Jordan and Snyder	L.S.J.U., Cat. 2,048	379

*Distribution*.—Maizuru, Tango (Ortmann); Bay of Tokio (Ortmann); Enoshima, Sagami (Ortmann); Wakanoura, Kii (!); Katsiyama (Ortmann); Kochi, Toza (Ortmann); Kagoshima, Satsuma (Ortmann); Nagasaki, Hizen (!).

***Sepia torosa*** Ortmann, 1888.

*Sepia torosa* Ortmann, 1888, pp. 652, 665, pl. 23, fig. 2.

*Sepia torosa* Ortmann, 1891, p. 674.

*Distribution*.—Bay of Tokio (type locality, Ortmann). Amboina (Ortmann).

***Sepia formosana*** new species. Pl. IX, fig; 7.

Body wide, stout, compressed, semi-elliptical. Fins nearly one third as wide as the body, widest near the middle and becoming very narrow posteriorly though nearly continuous around the

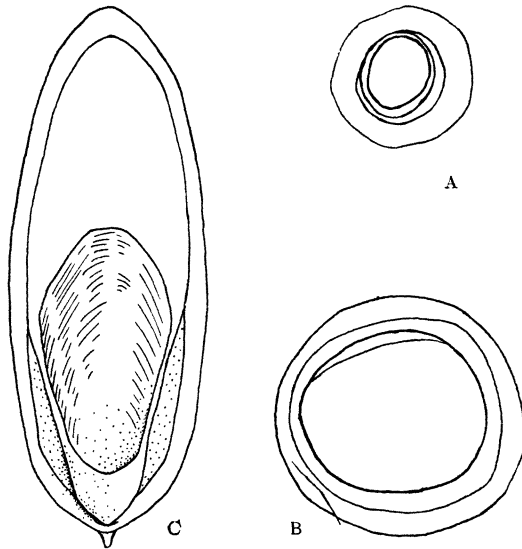


Fig. 2.—*Sepia formosana* [361]: a, camera outline of horny ring from third left arm, much enlarged; b, camera outline of horny ring of large tentacular sucker, same scale as preceding; c, ventral aspect of gladius, natural size.

extremity of the body. Mantle margin produced into a prominent rounded angle above, but truncate or slightly emarginate below.

Head broad, flattened. Eyes large, prominent. Funnel broad, truncate at the apex, the latter barely reaching the gap between the ventral arms.

Arms subequal, somewhat over a third as long as the body; all more or less compressed, the third and fourth pairs conspicuously

keeled. Membranes bordering the sucker-bearing area well developed. Suckers minute, cup-shaped, in four rows on all the arms; horny rings smooth. A narrow umbrella connects all the arms at the base.

Tentacles rather short, stout, the clubs very large. Suckers in about four to five rows; those of the two marginal series very minute, the median ones slightly larger and about six of the latter very much larger than any of the others, the three nearest the middle of the club being largest of all (Pl. IX, fig. 7). The latter have smooth horny rings while those of the smaller suckers seem to be very minutely denticulate or crenate.

Surface smooth throughout.

Color dull buff-gray, heavily mottled above and more lightly dotted below with blackish-slate-colored chromatophores.

Gladus elongate-elliptical in outline, a little over one-third as broad as long; chitinous margin quite wide and narrowly continuous posteriorly across the short stout straight spine. Dorsal surface finely rugose-granulose, the granules disposed in concentric series parallel to the anterior margin; two shallow converging grooves near the centre divide the shell into a narrow median and two wide lateral areas; the calcareous coating over the chitinous layer is very thin dorsally, especially near the edges. Ventral surface excavated posteriorly; the striated area occupies about half the length of the shell, but its extreme posterior portion is obscured by the heavy callous which strengthens the inner cone. The limbs of the callous arise near a point a little more than one-third the length of the shell from the posterior end. Locular index (inclusive of chitinous margin) about 43.

*Type*.—Cat. 2,049, Invertebrate Series, Stanford University Collections [S. S. B. No. 361].

*Type Locality*.—Takao, Formosa (Hans Sauter); one specimen.

#### *Measurements.*

	mm.
Tip of body to base of dorsal arms.....	82
Median length of mantle (dorsal).....	72
Median length of mantle (ventral).....	64
Width of mantle.....	37
Width of fin at widest point.....	11
Width of head.....	31
Length of funnel.....	26
Length of dorsal arm.....	35
Length of second arm.....	31

	mm.
Length of third arm.....	32
Length of ventral arm.....	34
Length of tentacle.....	45
Length of tentacle club.....	17
Diameter of largest tentacular suckers.....	3

Judging from the single specimen at hand (which, it must be confessed, is not in the best state of preservation), this little species approaches very closely to *S. torosa* Ortmann, but differs in (1) the decidedly more elongate outline of the body, (2) the smooth horny rings of the sessile arm suckers, and (3) the even more conspicuous enlargement of certain suckers on the tentacle club (decidedly more than "noch einmal so gross wie die übrigen"). The locular index of the gladius is about the same, unless in calculating it we exclude the chitinous margin, in which case the index is but about 37. The calloused area is, however, relatively greater.

Other allied forms appear to be *S. rouxii* d'Orbigny (Indo-Malayan), *S. microcotyledon* Ortmann (Ceylon), and possibly the Chinese *S. sinope* Gray, the two latter of which have been discussed by Ortmann (1891, p. 674). *S. microcotyledon* is the only one described as having smooth horny rings, but here the structure of the tentacle club is very different.

Curiously enough, I have been unable to discover any records of cephalopods from Formosa in any of the literature. Although my search may not have been exhaustive, it is probable that the three species here recorded (*Sepia formosana*, *Euprymna morsei*, and *Sepio-  
teuthis lessoniana*) are the first species to be accredited to the island.

Sub-genus DORATOSEPION (de Rochebrune, 1884):

***Sepia* (Doratosepion) *lorigera*** Wülker, 1910.

*Sepia lorigera* Wülker, 1910, p. 12, pl. 2, figs. 3, 4; pl. 3, figs. 11-14.

*Distribution*.—Near Misaki, Sagami (type locality, Wülker).

***Sepia* (Doratosepion) *andreana*** Steenstrup, 1879.

*Sepia Andreana* Steenstrup, 1875, pp. 474, 479, pl. 1, figs. 11-19.

*Sepia Andreana* Tryon, 1879, p. 193, pl. 89, fig. 408; pl. 90, figs. 409, 410 (after Steenstrup).

*Doratosepion andreana* de Rochebrune, 1884, p. 96.

*Sepia andreana* Ortmann, 1888, pp. 662, 665.

*Sepia andreana* Wülker, 1910, pp. 19, 22, 24.

*Distribution*.—Japan (Steenstrup).

**Sepia (Doratosepion) peterseni** Appellöf, 1886.

*Sepia Peterseni* Appellöf, 1886, p. 23, pl. 2, figs. 1-5; pl. 3, fig. 21.

*Sepia peterseni* Ortmann, 1888, pp. 663, 665.

*Sepia peterseni* Wülker, 1910, pp. 14, 19, 24.

*Distribution*.—Tokio Market (Wülker); near Misaki, Sagami (Wülker); Nagasaki, Hizen (type locality, Appellöf).

**Sepia (Doratosepion) andreanoides** Hoyle, 1885.

*Sepia andreanoides* Hoyle, 1885*b*, p. 193.

*Sepia andreanoides* Hoyle, 1885*d*, p. 297.

*Sepia andreanoides* Hoyle, 1886, pp. 139, etc., pl. 21, figs. 11-19; pl. 22, fig. 11.

*Sepia andreanoides* Ortmann, 1888, pp. 653, 665.

*Sepia andreanoides* Wülker, 1910, pp. 19, 22, 24.

*Distribution*.—Bay of Tokio (Ortmann); Yokohama Market (type locality Hoyle).

**Sepia (Doratosepion) kubiensis** Hoyle, 1885.

*Sepia kubiensis* Hoyle, 1885*b*, p. 195.

*Sepia kubiensis* Hoyle, 1885*d*, p. 300.

*Sepia kubiensis* Appellöf, 1886, p. 20, pl. 3, fig. 7.

*Sepia kubiensis* Hoyle, 1886, p. 142, pl. 18, figs. 7-14.

*Sepia kubiensis* Ortmann, 1888, pp. 654, 665.

*Sepia kubiensis* Hoyle, 1905, p. 982 (locality record).

*Sepia kubiensis* Wülker, 1910, pp. 16, 20, 24.

This is one of the most abundant Japanese species, but the condition of the material is such that I am in some doubt as to whether all of the following specimens are properly referred to it.

No. Sp.	Locality.	Collector.	Where deposited.	Author's Register.
13	Nagasaki, Hizen.....	Jordan and Snyder	L.S.J.U., Cat. 2,051	349
1	Hakodate, Hizen.....	Jordan and Snyder	L.S.J.U., Cat. 2,050	357
4	Hakodate, Hizen.....	Jordan and Snyder	L.S.J.U., Cat. 2,050	359

*Distribution*.—Bay of Tokio (Ortmann); Misaki, Sagami (Wülker); Kobe, Settsu (type locality, Hoyle); Katsiyama (Ortmann); Kagoshima, Satsuma (Ortmann); Nagasaki, Hizen (Appellöf, !); Hakodate, Hizen (!); Maizuru, Tango (Ortmann).

Kolumadulu Atoll, South Pacific (Hoyle).

**Sepia (Doratosepion) tokioensis** Ortmann, 1888.

*Sepia tokioensis* Ortmann, 1888, pp. 653, 665, pl. 23, fig. 3.

*Sepia tokioensis* Wülker, 1910, pp. 14, 20.

Three specimens taken by Jordan and Snyder at Aomori are perhaps to be referred to this species (Invertebrate Series Cat. No. 2,052, Stanford University Collections).

*Distribution*.—Aomori, Mutsu (!); Bay of Tokio (type locality, Ortmann); near Misaki, Sagami (Wülker).

**Sepia (Doratosepion) misakiensis** Wülker, 1910.

*Sepia misakiensis* Wülker, 1910, p. 15, pl. 1, figs. 5, 6; pl. 3, figs. 19, 22.

*Distribution*.—135 meters' depth, off Misaki, Sagami (type locality, Wülker).

**Sepia (Doratosepion) appellöfi** Wülker, 1910.

*Sepia appellöfi* Wülker, 1910, p. 14, pl. 1, fig. 8; pl. 3, figs. 15–18.

*Distribution*.—Near Misaki, Sagami (type locality, Wülker).

Genus **METASEPIA** (Hoyle, 1885).

**Metasepia tullbergi** (Appellöf, 1886).

*Sepia Tullbergi* Appellöf, 1886, p. 26, pl. 2, figs. 7–14.

*Sepia (Metasepia) tullbergi* Ortmann, 1888, pp. 656, 665.

*Distribution*.—Kadsiyama (Ortmann); Kagoshima, Satsuma (Ortmann); Nagasaki, Hizen (type locality, Appellöf).

Genus **SEPIELLA** (Gray, 1849).

**Sepiella inermis** (Van Hasselt MS., 1839) Steenstrup, 1880.

*Sepia inermis* Van Hasselt MS., in d'Orbigny and Férussac, 1839, p. 286, pl. 6, bis; pl. 20, figs. 1–9 (*vide* Hoyle).

*Sepia inermis* d'Orbigny, 1845, p. 295, pl. 12, figs. 9, 10.

*Sepia microcheirus* Gray, 1849, p. 107.

*Sepia inermis* Tryon, 1879, p. 196, pl. 91, fig. 423; pl. 92, figs. 424, 425.

*Sepia inermis* Steenstrup, 1875, p. 478, pl. 2, fig. 3.

*Sepiella inermis* Steenstrup, 1880a, pp. 347–356, figs. 1–8.

*Sepiella inermis* Joubin, 1897a, p. 103.

*Sepiella inermis* Joubin, 1898, p. 25.

*Sepiella inermis* Hoyle, 1905, p. 982, fig. 152.

*Distribution*.—Japan (Joubin). Timor (Joubin); Batavia, Java (d'Orbigny); Male Atoll (Hoyle); Pondicherry (d'Orbigny); Coromandel (d'Orbigny); Bombay (d'Orbigny).

**Sepiella maindroni** de Rochebrune, 1884.

*Sepiella Maindroni* de Rochebrune, 1884, p. 89.

*Sepiella maindroni* (?) Hoyle, 1886, pp. 26, 149, etc., pl. 22, figs. 1–10.

*Sepiella maindroni* Ortmann, 1888, pp. 663, 665 (merely listed).

*Sepiella maindroni* Wülker, 1910, pp. 20, 23.

*Distribution*.—Tokio Market (Wülker); near Aburatsubo, Sagami (Wülker); Inland Sea (Hoyle). Pondicherry (type locality, de Rochebrune).

Division **ÆGOPSIDA** d'Orbigny, 1839.

Family **GONATIDÆ** (Hoyle, 1886).

Genus **GONATUS** Gray, 1849.

**Gonatus fabricii** (Lichtenstein, 1818) Steenstrup, 1880.

*Onychoteuthis Fabricii* Lichtenstein, 1818, p. 13 (*vide* Hoyle).

*Onychoteuthis Kamtschatica* Middendorff, 1849, p. 515, pl. 12, figs. 1–6.

*Gonatus Fabricii* Steenstrup, 1881a, p. 9, pl. 1.

*Gonatus fabricii* Pfeffer, 1900, p. 163.

*Gonatus fabricii* Berry, 1912, p. 308, pl. 52, figs. 1–4; pl. 53; pl. 54, figs. 1–4; pl. 55.

I have already given a full bibliography of this widely distributed

species in the paper cited. It has been reported from Shumshu Island, Kurile Group, by Middendorff, and from Japan without more definite locality by Steenstrup. It probably inhabits the whole northern part of the archipelago.

Family **ENOPLOTEUTHIDÆ** Pfeffer, 1900.

Sub-family **ENOPLOTEUTHINÆ** Chun, 1910.

Genus **ABRALIOPSIS** Joubin, 1896.

**Abraliopsis scintillans** Berry, 1911. Pls. VII, VIII; pl. IX, figs. 1-6.

? *Abraliopsis* sp. Nishikawa 1906a, p. 310 (eggs).

*Abraliopsis scintillans* Berry 1911a, p. 93.

Animal small, loliginiform; the mantle thin, cylindrical in front; slender and tapering rapidly to an acute point posteriorly. Fins very large, broadly sagittate, over three-fifths as long as the mantle, their total width at the point of greatest expansion about the same as the length; forward margins arcuate, descending abruptly inward from a nearly right angle anteriorly; angles of lateral margins rounded, a little less than right, well anterior of the middle; hinder margins concave, produced posteriorly to an acute point. Anterior mantle margin slightly produced to form an obtuse median point above and a lateral angle on either side of the funnel.

Head large, flattened, excavated beneath. Eyes enormous, rounded and frequently much protruding in preserved specimens; ocular apertures large, with a distinct sinus in front. Funnel broad, compressed, little projecting; interior with a pocket-like valve near the tip; funnel organ comprising a large  $\wedge$ -shaped median pad, with notably expanded limbs posteriorly situated on the dorsal wall, and two ovate ventro-lateral cushions (Pl. IX, fig. 5).

Each funnel-locking cartilage a large elongate-ovate plate, deeply excavated down the centre, the elevated margin conspicuously reflected, its cavity corresponding with a simple linear groove about 8 mm. long on the inner surface of the mantle.

Arms of moderate length, nearly equal, the order of length in general 4, 3 = 2, 1, though the third pair is sometimes a little longer than the second. In detailed structure the arms differ considerably; for the sake of more accurate observation, those of the left side of one specimen were removed and have furnished the following account. Dorsal arm armed with 12 small stout hooks in two alternating rows, replaced by numerous minute suckers in two series at the extremity; on the outer margin along the whole length, except at the extreme base, is a broad colorless keel, widest below the middle of

the arm; along the ventral margin of the sucker-bearing area is a delicate hyaline swimming membrane supported by a series of fleshy lappets about equal in longitude to the hooks opposite which they lie. Second arm also with 12 hooks (though on the right second arm of another specimen 14 hooks were counted) and otherwise in all essentials like the first. The third arm likewise has 12 hooks succeeded by minute suckers at the tip; it is, however, more robust than any of the others; a very broad conspicuous hyaline membranous keel, unadorned with chromatophores on either surface, runs along the outer margin, at its widest point (near the middle) exceeding the diameter of the arm itself; ventral margin furnished with a hyaline swimming membrane as above, but its trabeculae are much longer and larger. Ventral arm (Pl. IX, fig. 4) with 11-12 hooks and no suckers, the whole extremity of the arm being bare except for the curious terminal organs described below; longer and more gradually tapering than the other arms, the hooks slightly smaller; devoid of swimming membranes, but there is a well-developed keel along the outer (dorsal) angle; the tip of each ventral arm is occupied by a longitudinal series of three large, ovoid, heavily pigmented, bead-like organs of a blackish color succeeded distally by one or two minute rudiments of similar structures where the tip of the arm suddenly tapers to a point; these are little protruding and have the superficial appearance of being enveloped within the substance of the arm itself, though really enclosed in the integument on the side of the latter; in size the central organ perhaps slightly surpassing the others (Pl. IX, fig. 1).

As all the specimens seen are females, the hectocotylized arm and other sexual characters have not been observed.

Tentacles slender, about the length of the mantle, sides compressed and somewhat flattened, inner surface of stalk flattened. Clubs little or not at all expanded, the distal two-thirds armed with four distinct crowded rows of minute suckers, some 74 to 76 in all,<sup>12</sup> regularly diminishing in size toward the tip; proximal to these and projecting well out beyond the ventral margin are two very large, elongate, slender, strongly incurved, sharply pointed hooks projecting for some distance from their large fleshy bases; opposite these along the dorsal margin a single series of exceedingly minute short-pediceled suckers, usually four in number and apparently

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<sup>12</sup> Cf. the figure given by Chun of *A. morisii* ♀ (1910, pl. 8, fig. 3), where but about 40 such suckers are shown occupying a relatively much smaller proportion of the entire club.



homologous with the most marginal row of the distal suckers; proximal to the hooks and in a line with them on the right tentacle club is usually situated a single minute sucker similar to those just described. Certain variations occur, as (*e.g.*) in the club from which the accompanying figure (Pl. IX, fig. 6) was drawn; here the small suckers opposite the hooks were apparently wanting (through abrasion?) and were supplied in the drawing from another specimen. The general character and extent of these variations are well brought out in the accompanying table of data taken from all the specimens examined and would seem to indicate that where the number of minute suckers is fewer than that above regarded as typical, it may be due to the facility with which such delicate structures may be lost by abrasion.

Tentacle.		No. of large hooks in ventral row.	No. suckers proximal to hooks in ventral row.	No. suckers opposite to hooks in dorsal row.	No. suckers in fixing apparatus.	No. pads in fixing apparatus.	Arrangement of fixing apparatus.
1	Right.....	2	1	5	4	4	Compact.
	Left.....	2	0	4	4	4	"
2	Right.....	2	1	4	4	4	"
	Left.....	2	0	.....	4	4	"
3	Right.....	.....	.....	.....	.....	.....	.....
	Left.....	2	0	0	4	4	Diffuse.
4	Right.....	2	0	4	4	4	Compact.
	Left.....	2	0	3	4	4	Diffuse.
5	Right.....	2	1	4(+1?)	4	4	Medium.
	Left.....	2	0	2(+?)	4	4	Compact.
6	Right.....	2	0	4 <sup>13</sup>	3	3	Medium.
	Left.....	2	0	3	3	3	Compact.

Fixing apparatus well developed and with one exception very constant in comprising four minute suckers and four pads regularly alternating in two rows; sometimes these are relatively distant as in the figure, but often more compactly grouped. The distal (sucker-bearing) part of the club is furnished with a membranous keel along its dorsal margin (Pl. IX, fig. 6).

Buccal membrane eight-pointed, papillose within; its color deep violet, the supporting lappets of a conspicuously paler shade outwardly.

Gladus (fig. 3) with broad wings, embracing the slender midrib for quite three-quarters of its length; only slightly subangulate laterally at the point of widest expansion. Keel plainly visible through the dorsal integument as a dark median line.

<sup>13</sup> Here a small sucker is also present between this row and the proximal hook.

Radula not examined.

Integument with numerous minute photogenic organs, appearing as dark bluish dots having a distinctly paler centre. These are distributed as follows: (1) on the ventral surface of the mantle they are everywhere exceedingly numerous and so evenly distributed that a bilateral arrangement is only apparent after close examination, being even then not at all absolute; definite rows indistinguishable except for a narrow but distinct and fairly conspicuous area entirely free of photophores and forming a straight longitudinal band down the medio-ventral line with a fairly constant width of scarce more than a millimeter throughout its course; the number of photophores in one of the rows bordering it is from 42 to 45. Laterally, the organs rapidly scatter and diminish in size until they

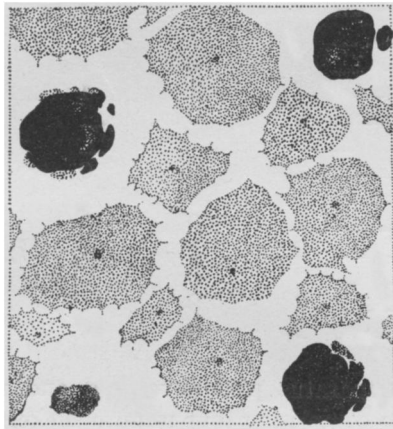


Fig. 3.—*Abraliopsis scintillans*, dorsal aspect of gladius, natural size; [147].  
Fig. 4.—*Abraliopsis scintillans*, portion of integument from ventral surface of mantle seen by reflected light, showing photophores and chromatophores; from an unstained mount in balsam; greatly enlarged; [147].

are only with difficulty to be made out at all. However, I have been unable to find that they extend very much past the level of the eyes.

2. On the ventral aspect of the funnel the photogenic organs are similar in character to those of the mantle, but are fewer in number and therefore appear more symmetrically disposed. They are ranked in about ten poorly defined longitudinal rows, variously distant and containing 3–4 organs each, but the arrangement of the two lateral halves is alike and here again they are separated by a clear space down the middle.

3. On the ventral surface of the head the photophores have evidently a primary arrangement in longitudinal series, but this has become so modified by the interpolation of various shorter series and isolated organs that the exact number of rows is difficult to determine. Most apparent are (*a*) the usual median row which bifurcates at the apex of the funnel groove and at the base of the ventral arms, along which latter its two branches continue for the proximal two-thirds of their length; (*b*) a long lateral series beginning on the ventral fold of the olfactory crest which curves inward on the head and also continues out the ventral arms to their extremities; (*c*) a very distinct circlet of more ovoid organs surrounding the ocular aperture (Pl. IX, fig. 2).

4. The ventral arms as just noted have two rows of photophores upon the arm itself, and in addition a distinct row of 7-8 small very distant organs along the outer margin of the keel. The third arms have but a single row of 4-5 organs along their ventral aspect. On the remaining arms, on the tentacles, and on the dorsal surface of the head no luminous organs were observed.

In addition to the photogenic organs of the general integument and the curious pigmented structures already described at the tips of the ventral arms, there is a third very distinct type of photophore in the form of a series of small circular bead-like bodies, brownish-orange in color, on the ventral periphery of the eyeball; these are five in number, the three central ones smallest and interspaced from one another about a millimeter; the two terminal ones are each distant about  $1\frac{1}{2}$  mm. from the neighboring organ and their diameter is about twice as great (*i.e.*, rather less than a millimeter) (Pl. IX, fig. 3). These organs, though situated on the eyeball itself, are usually visible even when the latter is closely retracted, because of a small ovate hyaline non-pigmented area in that portion of the ventral integument which normally covers them. When, as sometimes occurs, this area is iridescent and a little distended, it becomes quite conspicuous. Its purpose is obviously to allow the rays of light from these organs to pass through the outer integument with as little obstruction as possible.

Color in life not observed; in alcoholic specimens the ground color is a pale brownish-buff, dotted over nearly the entire surface with small and very beautiful reddish-brown chromatophores, which are especially numerous and darkest just above the keel of the gladius, but thickly scattered, even on the ventral surface where they are very conspicuous among the bluish photophores. On

the under sides of the fins, the hyaline area above described, the inner surfaces of the arms, and the keels of the three dorsal pairs the skin is nearly or entirely free of chromatophores. Because appearing with unusual constancy, a single large chromatophore, surrounded by a circlet of smaller ones and situated on the head just posterior to the crotch between the dorsal arms, is also probably worthy of mention. The lens of the eye is large, spherical, and exquisitely pearly.

*Measurements.*

Author's register.....	147			279		
Specimen number.....	1	2	3	4	5	6
	mm.	mm.	mm.	mm.	mm.	mm.
Length, total.....	132	119	.....	125	117	123
Length, exclusive of tentacles	95	91	86	97	93	98
Length of mantle, dorsal.....	59	55	52	60	57	55
Width of mantle.....	16	15	13	15	14	17
Width across fins.....	38	38	37	45	40	46
Length of fins, total.....	39	36.5	34	38	35	38
Length of fins along plane of attachment.....	33.5	33	30	33	30	32
Width across head.....	17	18	17	15	13	15
Width between eyes.....	8	7	7.5	9	7	8
Length of head, dorsal.....	12	11	12	11	11	12
Length of right dorsal arm.....	19	17	19	23	22	22
Length of left dorsal arm.....	21	18	20	22	22	22
Length of right second arm.....	22	23	22	25	26.5	25
Length of left second arm.....	22	23	22	25	25	26
Length of right third arm.....	23	23	22	25	24	25
Length of left third arm.....	24	23	23	25	25	25
Length of right ventral arm.....	26	28	26	28	28	31
Length of left ventral arm.....	27	24	.....	27.5	28	31.5
Length of right tentacle.....	59	55	.....	56	52	56
Length of left tentacle.....	65	51	.....	53	48	55
Length of tentacle club.....	7	7	.....	7	7	7.5
Length of funnel.....	.....	.....	9	.....	.....	.....

*Type*.—Cat. No. 2,053. Invertebrate Series, Stanford University collections [S. S. B. No. 147]; a female.

*Type Locality*.—Japan, probably off Misaki (Alan Owston ?); three ♀ specimens.

*Material Examined*.—In addition to the three cotypes, three other specimens, taken at Misaki by Ishikawa [S. S. B. No. 279], have been examined. All six are females. In the tables they have been numbered, respectively, 1-3 and 4-6, and the specimens denoted as Nos. 3 and 5 have been destroyed by dissection.

*Remarks.*—This beautiful little squid was originally described from three individuals in the Stanford University collections thought to be from Japan, but in reality of quite uncertain origin. This habitat was, however, confirmed in a most interesting manner, almost immediately upon the preparation of the original diagnosis, by the receipt through the kindness of Dr. Harold Heath of three "squids with luminous dots," sent to him from Japan by Dr. Ijima. These were the specimens mentioned above from Misaki and proved to be identical in every essential feature with the types, entirely confirming in every particular the characters which I had depended upon as diagnostic. Both the Stanford specimens and those sent by Dr. Ijima are beautifully preserved, are nearly of the same size, and apparently fully grown. One of the largest, if not the largest species of the genus, *A. scintillans*, is differentiated from the previously described forms in the following apparently constant characters:

1. The great number of photophores on the ventral surface and the comparative obscurity of their bilateral arrangement as well as the absence of distinct longitudinal series.

2. The presence of only one row of hooks (the ventral) on the tentacle club, with but two elements present even here.

3. The replacement of the dorsal row of hooks present in other species by a single or slightly zigzag series of minute suckers.

4. The large number of suckers in the four distal rows on the club and the fact that these occupy nearly two-thirds of the total length.

5. The usual presence of four suckers and four pads in the fixing apparatus.

6. The detailed structure of the sessile arms which appears to differ constantly from the careful account given by Hoyle (1904, p. 37) in regard to *A. hoylei*.

With these features in mind, it is by no means difficult to separate *A. scintillans* from either the Atlantic *A. pfefferi* or the *A. hoylei* of the South and East Pacific,<sup>14</sup> with both of which it is, however, closely allied. It is to be expected that any structure so complex

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<sup>14</sup> Chun, in a recent monograph (1910, p. 78), unites both of these forms under the earliest name applied to a member of the genus, *A. morisii* Vérany, 1837, and gives a large number of exquisitely beautiful figures of a series supposed to be identical. The evidence offered is certainly suggestive, but does not appear to the present writer to be conclusive proof that we have but a single cosmopolitan species of *Abrahiopsis*, however closely related otherwise the various forms may be.

as the armature of the tentacle club should be subject to a considerable degree of variation among its constituent elements, so that its great constancy in the present series is really quite surprising and indicates that it may prove especially important in distinguishing species. The discovery of males of this species should throw an interesting light upon the entire subject.

In gross aspect and general outline of the body there is great variation, depending upon the conditions of preservation. The greatest individualities observed are in the form of the mantle. Sometimes the outline tapers smoothly and regularly from the anterior margin, or there may be a pronounced bulging near the middle, or sometimes a general inflation of the whole.

Genus **THELIDIOTEUTHIS** Pfeffer, 1900.

**Thelidioteuthis alessandrinii** (Vérany, 1851) Chun, 1910.

*Loligo Alessandrinii* Vérany, 1851, p. 99, pl. 35, figs. f, g, h (*vide* Chun).

*Enoplateuthis polyonyx* Troschel, 1857, p. 67, pl. 4, fig. 9.

*Thelidioteuthis polyonyx* Pfeffer, 1900, p. 167.

*Thelidioteuthis Alessandrinii* Chun, 1910, p. 104, pl. 7, figs. 16, 17.

A specimen in the possession of the writer from the Gulf of Kago-shima appears to be a young individual of this widely distributed species, though it is possible that the adult might show differences worthy of separate recognition. [S. S. B. No. 274.]

*Distribution*.—Gulf of Kagoshima (!). Mediterranean; South Atlantic (Pfeffer); Indian Ocean (Chun); Society Islands (Pfeffer).

Family **OCTOPODOTEUTHIDÆ** new name.

(= *Veranyidæ* Chun, 1910.)

Genus **OCTOPODOTEUTHIS** Rüppell, 1844 (em.).

**Octopodoteuthis** sp.

*Octopodoteuthis* near *O. sicula* Chun, 1910, p. 139.

In the work cited Chun mentions a specimen of this genus taken by Döfle in Sagami Bay.

Family **HISTIOTEUTHIDÆ** Verrill, 1881.

Genus **CALLITEUTHIS** Verrill, 1880.

**Calliteuthis ocellata** (Owen, 1881) Verrill, 1881.

*Loligopsis ocellata* Owen, 1881, p. 139, pl. 26, figs. 3–8; pl. 27.

*Calliteuthis ocellata* Verrill, 1881, p. 402.

*Calliteuthis ocellata* Verrill, 1882, p. 412 [202].

*Calliteuthis reversa* Hoyle, 1886, p. 183, pl. 33, figs. 12–15 (not of Verrill).

*Calliteuthis reversa* (pars) Pfeffer, 1900, p. 170.

*Calliteuthis reversa* (pars) Chun, 1906, p. 744.

*Calliteuthis ocellata* Chun, 1910, pp. 149, 170, etc., Texttafel 1, figs. 1, 2; text figs. 22, 23; pl. 20, figs. 7–9.

The true *Calliteuthis reversa* Verrill is not yet known to be a member

of the Japanese fauna. Assuming the correctness of the recent careful synopsis of the genus given by Chun (1910), the various references to it in the literature cited have certainly been based upon misidentifications.

*Distribution*.—Sagami Bay (Chun); 345 fathoms, off Ino Sima Island (Hoyle); China Sea (type locality, Owen).

Family **ARCHITEUTHIDÆ** Pfeffer, 1900.

Genus **ARCHITEUTHUS** Steenstrup, 1856.

**Architeuthus martensii** (Hilgendorf, 1880) Steenstrup, 1882.

*Megateuthis Martensii* Hilgendorf, 1880, p. 65.

*Architeuthus Martensii* Steenstrup, 1882, p. 157 [15].

*Architeuthis*, sp. Mitsukuri and Ikeda, 1895, pp. 39–50, 1 pl. (*vide* Hoyle).

*Distribution*.—Japan (Hilgendorf).

Family **OMMASTREPHIDÆ** Gill, 1871.

Genus **OMMASTREPHE**s d'Orbigny, 1835.

**Ommastrephes sloanii** Gray, 1849. Pl. VI, fig. 4.

*Ommastrephes Sloanii* Gray, 1849, p. 61.

*Ommastrephes Sloanii* Tryon, 1879, p. 180 (after Gray).

*Todarodes pacificus* Steenstrup, 1880, pp. 83, 90, etc. (*vide* Hoyle).

—(?) *Sloanei* Steenstrup, 1880, p. 98.

*Ommastrephes sloanei* Verrill, 1881, p. 386 (brief note).

*Ommastrephes pacificus* Appellöf, 1886, p. 35, pl. 3, figs. 8–10.

*Todarodes pacificus* Hoyle, 1886, pp. 34, 163, 219, pl. 28, figs. 1–5.

*Todarodes pacificus* Ortmann, 1888, pp. 664, 665 (merely listed).

? *Ommastrephes gouldi* M'Coy, 1888.

? *Ommastrephes gouldi* Brazier, 1892, p. 17 (locality record).

*Todarodes pacificus* Joubin, 1897a, p. 103.

not ? *Ommastrephes sloanei* Schauinsland, 1899, p. 92 (mere note).

*Ommastrephes sagittatus sloanei* Pfeffer, 1900, p. 179.

[Pfeffer also unites with this species the *O. insignis* of Gould, 1852, ascribed to the Fiji Islands and the Antarctic region.]

Body elongate, cylindric, tapering posteriorly to a sharp point between the fins. Mantle margin entire above and but little emarginate below. Fins broadly sagittate, in the adult a little more than two-fifths as long as the mantle. Mantle connectives as usual in the group.

Head rather small, squarish, but much compressed, considerably narrower than the widest expansion of the body; bounded posteriorly by a transverse thickened ridge, continuous with the three oblique ear-like folds behind each eye. Eyes large, the wide lid openings with a narrow incision or sinus in front. Funnel groove with a distinct foveola in its anterior portion, comprising a horseshoe-

shaped fold of membrane embracing between its arms a series of 8-10 shorter and more fleshy longitudinal folds.

Arms moderate, squarish, fairly attenuate, averaging about half as long as the mantle; unequal, the order of length almost always 2, 3, 1, 4, although there are occasionally slight variations from this formula. Umbrella lacking, but the outer angles of all the arms equipped with a firm fleshy keel especially developed on the basal half of the third pair, and a delicate trabeculated swimming membrane, which is least evident on the ventral arms and widest on the ventral margin of the third pair. Suckers decidedly small (Pl. VI, fig. 4); rather distantly placed at the base in two regularly alternating rows, becoming more crowded at the tip; the interspacing between the rows very variable, apparently dependent mainly upon the degree of compression of the arms; suckers of the lateral arms slightly, but not at all conspicuously larger than those of the dorsal and ventral pairs; on an arm of the second pair some 56 to 60 suckers can readily be counted without using a lens. Horny rings well developed, their lower margins ordinarily smooth, but with 9 to 12 stout acute teeth, accompanied by occasional intervening denticles on the upper edge; these teeth are largest at the apex, but the median one is not particularly differentiated in this respect more than its neighbors.

Tentacles stout, moderate; the club slightly expanded, its sucker-bearing portion including about 60-65% of the total length in the adult (55-71%, according to Pfeffer); in general structure entirely similar to *O. hawaiiensis*,<sup>15</sup> the horny rings of the large median suckers armed with about 17 rather short, stout, acute, subequal teeth, occurring in regular alternation with an equal number of very low squarish plates, both teeth and plates being more regular, though somewhat more weakly developed than in *O. hawaiiensis*. A small sucker of the marginal rows shows about 18 acute teeth, larger and longer on the upper margin where they are accompanied by a few alternating denticles.

In young specimens, such as No. 273, the body appears more slender and the fins much shorter, both in proportion to the mantle length and their own width.

The chief measurements of eight specimens are given in the following table:

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<sup>15</sup> *Ommastrephes hawaiiensis* new species: A Hawaiian form closely allied to *O. sloanii* (i.e., *pacificus*), but with much larger and fewer suckers on the sessile arms of the adult and with the central upper tooth of the horny rings distinctly larger than any of the others.



*Measurements.*

Author's register number.....	[286] mm.	[258] mm.	[257] mm.	[257] mm.
Length, total.....	393	332	329	316
Length, exclusive of tentacles.....	310	263	277	279
Length of mantle, dorsal.....	168	164	159	170
Width of mantle, median.....	50 <sup>16</sup>	28	42 <sup>16</sup>	35
Width across fins.....	111	80	95	87
Length of fins, total.....	78	66	67	67
Length of fins along plane of attachment.....	72	62	58	62
Length of head.....	37	23	24	24
Width of head.....	33	22	26	32
Length of right dorsal arm.....	101	67	79	72
Length of right second arm.....	113	74	97	85
Length of right third arm.....	111	68	91	85
Length of right ventral arm.....	90	63	71	67
Length of right tentacle, total.....	205	135	149	118
Length of right tentacle, sucker-bearing portion.....	125	81	91	74
Length of left tentacle, total.....	202	152	138	120
Length of left tentacle, sucker-bearing portion.....	123	90	86	78
Author's register number.....	[257] mm.	[257] mm.	[257] mm.	[273] mm.
Length, total.....	301	292	279	83
Length, exclusive of tentacles.....	253	256	250	73
Length of mantle, dorsal.....	155	161	156	45
Width of mantle, median.....	31	42 <sup>16</sup>	34	10 <sup>16</sup>
Width across fins.....	81	84	77	19
Length of fins, total.....	64	69	66	12
Length of fins along plane of attachment.....	59	63	59	11.5
Length of head.....	21	22	25	8
Width of head.....	21	31 <sup>16</sup>	22	10
Length of right dorsal arm.....	66	66	62	17
Length of right second arm.....	78	77	75	19
Length of right third arm.....	75	77	70	18
Length of right ventral arm.....	60	66	60	14
Length of right tentacle, total.....	126	111	106	31
Length of right tentacle, sucker-bearing portion.....	83	71	67	17
Length of left tentacle, total.....	123	111	106	27
Length of left tentacle, sucker-bearing portion.....	81	71	68	14

<sup>16</sup> Badly compressed dorso-ventrally.

*Type*.—Of *sloanii*, in the British Museum; of *pacificus*, in the Copenhagen Museum.

*Type Locality*.—Of *sloanii*, Waitemata, New Zealand (Gray); of *pacificus*, Hakodate, Japan (Steenstrup).

*Distribution*.—Tomakomai, Iburi (!); Todohokke, Oshima (Wülker); Hakodate, Oshima (Steenstrup, !); Tokio (!); Misaki, Sagami (Wülker, !); Aburatsubo, Sagami (Wülker); Inland Sea (Hoyle); Nagasaki, Hizen (Appellöf). Vladivostok (Joubin); Indian Ocean (Gray); Victorian Water, South Australia (Brazier, as *O. gouldi*); Tasmania (Verrill); Waitemata, New Zealand (Gray).

*Material Examined*.—

No. Sp.	Locality.	Collectors.	Where deposited.	Author's Register.
1	Tomakomai, Iburi.....	J. O. Snyder	L.S.J.U., Cat. 2,057	273
2	Hakodate, Oshima.....	J. O. Snyder	L.S.J.U., Cat. 2,056	258
9	Hakodate, Oshima.....	Jordan and Snyder	L.S.J.U., Cat. 2,055	257
1	Tokio.....	Jordan and Snyder	L.S.J.U., Cat. 2,058	256
1	Misaki, Sagami.....	Jordan and Snyder	L.S.J.U., Cat. 2,059	259

Under the name *Ommastrephes Sloanii*, J. E. Gray in 1849 published the description of a species of squid from New Zealand belonging to the typical group of the genus and having probable relationship with *O. sagittatus*.<sup>17</sup> Subsequently Steenstrup (1880) erected a new species of his genus *Todarodes* (= *Ommastrephes* s. s.) for the reception of an apparently very similar cephalopod in the Copenhagen Museum from Hakodate, his description being supplemented by Hoyle with further interesting notes in the Challenger Report (1886) and a very excellent series of figures which fix the identity of the

<sup>17</sup> "*Ommastrephes Sloanii*."

"Body cylindrical, rather tapering behind. Fin rhombic, rather more than one-third the length of the body. Sessile arms compressed; cups equal, oblique, in two rows; rings black, higher side with regular acute teeth, lower smooth; third pair acutely finned, with a narrow, rayed, membrane on the inner edge of the ventral side. Tentacular arms slightly keeled externally, base half-naked; cups of lower part small, in two rows, of middle four rows, the seventh pair of the central series largest; rings with distant teeth all round; of the lateral series small, longly peduncled, and very oblique; of the apical portion small, in three or four rows, the smallest one nearly sessile." (Gray, 1849, p. 61.)

form intended beyond any manner of doubt. It is interesting to observe that Steenstrup himself affirms entire ignorance of the true generic position of *O. sloanii*, although Hoyle in the work cited referred it doubtfully to *Todarodes*. More recently Pfeffer (1900) has come to the conclusion that the two forms are identical and has, moreover, reduced them to subspecific rank under the Atlantic *O. sagittatus*. If these premises are correct, the rejection of the name *pacificus* in favor of the prior *sloanii* follows as a matter of course, an arrangement which has since been followed by Hoyle (1909) and by Wülker (1910), and is therefore adopted in this paper. To the present writer, however, this interpretation does not appear by any means conclusive. In the first place, the description of Gray when judged by modern standards is at best incomplete, and an examination of his type or even of further South Pacific material may yet reveal that he overlooked characters of sufficient importance to delimit this race from the Japanese form as completely as the latter now appears to be separated from its Mid-Pacific (Hawaiian) congeners. In the same connection another small item of evidence should not be overlooked: so careful an observer as Verrill (1881, p. 386) relates that a Tasmanian specimen referred by him to *O. sloanii* lacks the foveola at the apex of the funnel groove so characteristic of *O. sagittatus*, *pacificus*, and *hawaiiensis*. In any case, the specimens now before me are most certainly identical with the true *O. pacificus* as described and figured by Steenstrup and Hoyle, whether the latter eventually prove distinct from *sloanii* or not.

A key to the various known races of typical *Ommastrephes*, constructed on the same general plan as that utilized by Pfeffer, is accordingly offered as follows:

- |   |                      |
|---|----------------------|
| Sucker-bearing portion of the tentacle comprising more than $\frac{3}{4}$ of the total length (Atlantic species).....           | <i>sagittatus</i> .  |
| Sucker-bearing portion of the tentacle comprising distinctly less than $\frac{3}{4}$ of the total length (Pacific species)..... | 1                    |
| 1. { Median upper tooth of the horny rings of the suckers on the sessile arms obviously the largest.....                        | <i>hawaiiensis</i> . |
| 1. { No single tooth of the horny rings noticeably larger than the others.....  | <i>sloanii</i>       |

Most recent authors follow Pfeffer in regarding *sloanii* as a subspecies of *sagittatus*, but despite the small differences I cannot see that anything is to be gained by the use of the trinomial, especially since truly intergrading forms are not yet known to occur.

Genus **SYMPLECTOTEUTHIS** Pfeffer, 1900.

**Symplectoteuthis oualaniensis** (Lesson, 1830) Pfeffer, 1900.

*Loligo oualaniensis* Lesson, 1830, p. 240, pl. 1, fig. 2.

*Symplectoteuthis oualaniensis* Pfeffer, 1900, p. 180.

*Symplectoteuthis oualaniensis* Wülker, 1910, p. 21 (merely noted).

*Distribution*.—Near Misaki, Sagami (Wülker). Laccadive Islands (Hoyle); Vanikoro (Quoy and Gaimard); Caroline Islands (Lesson); Torres Straits, Great Barrier Reef, and Nickol Bay, Australia (Brazier); Laysan Island (Schauinsland); Cocos Islands (Hoyle).

Family **THYSANOTEUTHIDÆ** Keferstein, 1866.

Genus **THYSANOTEUTHIS** Troschel, 1857.

**Thysanoteuthis rhombus** Troschel, 1857.

*Thysanoteuthis rhombus* Troschel, 1857, p. 70, pl. 4, fig. 12; pl. 5, figs. 1–4.

*Thysanoteuthis rhombus* Jatta, 1896, p. 56, pl. 9, figs. 1–13.

*Thysanoteuthis rhombus* Pfeffer, 1900, p. 182.

An Atlantic and Mediterranean species quoted from Japan without more definite locality on the authority of Pfeffer.

Family **CHIROTEUTHIDÆ** Gray, 1849.

Sub-family **CHIROTEUTHINÆ** Chun, 1908.

Genus **CHIROTEUTHIS** d'Orbigny, 1839.

**Chireuteuthis macrosoma** Goodrich, 1896.

*Chireuteuthis macrosoma* Goodrich, 1896, p. 12, pl. 3, figs. 51–57.

*Chireuteuthis macrosoma* Pfeffer, 1900, pp. 185, 186.

*Chireuteuthis macrosoma* Nishikawa, 1906, pp. 109–113, pl.

*Chireuteuthis macrosoma* Chun, 1910, p. 240.

*Distribution*.—Japan (Nishikawa). Off the Kistna Delta (type locality, Goodrich).

Sub-genus **CHIROTHAUMA** Chun, 1910.

**Chireuteuthis (Chirothauma) imperator** Chun, 1908.

*Chireuteuthis imperator* Chun, 1908, p. 88.

*Chireuteuthis (Chirothauma) imperator* Chun, 1910, pp. 240, 241; texttafel 2; pl. 38; pl. 39, figs. 1–10; pl. 40, figs. 2–5, 7; pl. 41; pl. 42, figs. 1–4; pl. 43; pl. 44, figs. 3, 6–16.

*Distribution*.—Sagami Bay (Chun). Off Nias, Sumatra (type locality, Chun).

Family **CRANCHIIDÆ** Gray, 1849.

Genus **LIOCRANCHIA** Pfeffer, 1884.

**Liocranchia** sp.

A single very immature individual of an undetermined *Liocranchia* from Japan is in the author's collection [S. S. B. No. 385].

Order **TETRABRANCHIATA** Owen, 1832.Sub-order **NAUTILOIDEA**.Family **NAUTILIDÆ** Owen, 1836.Genus **NAUTILUS** Linné, 1758.**Nautilus pompilius** Linné, 1758.*Nautilus Pompilius* Linné, 1758, p. 709, Nos. 283, 233.*Nautilus Pompilius* Lischke, 1869, p. 29 (mere note).*Nautilus Pompilius* Dunker, 1882, p. 1 (mere note).*Nautilus* sp. Dean, 1901, p. 819.

*Distribution*.—Japan (Dunker); near Misaki, Sagami (Dean); Loo Choo Islands (Lischke). Indo-Malayan region.

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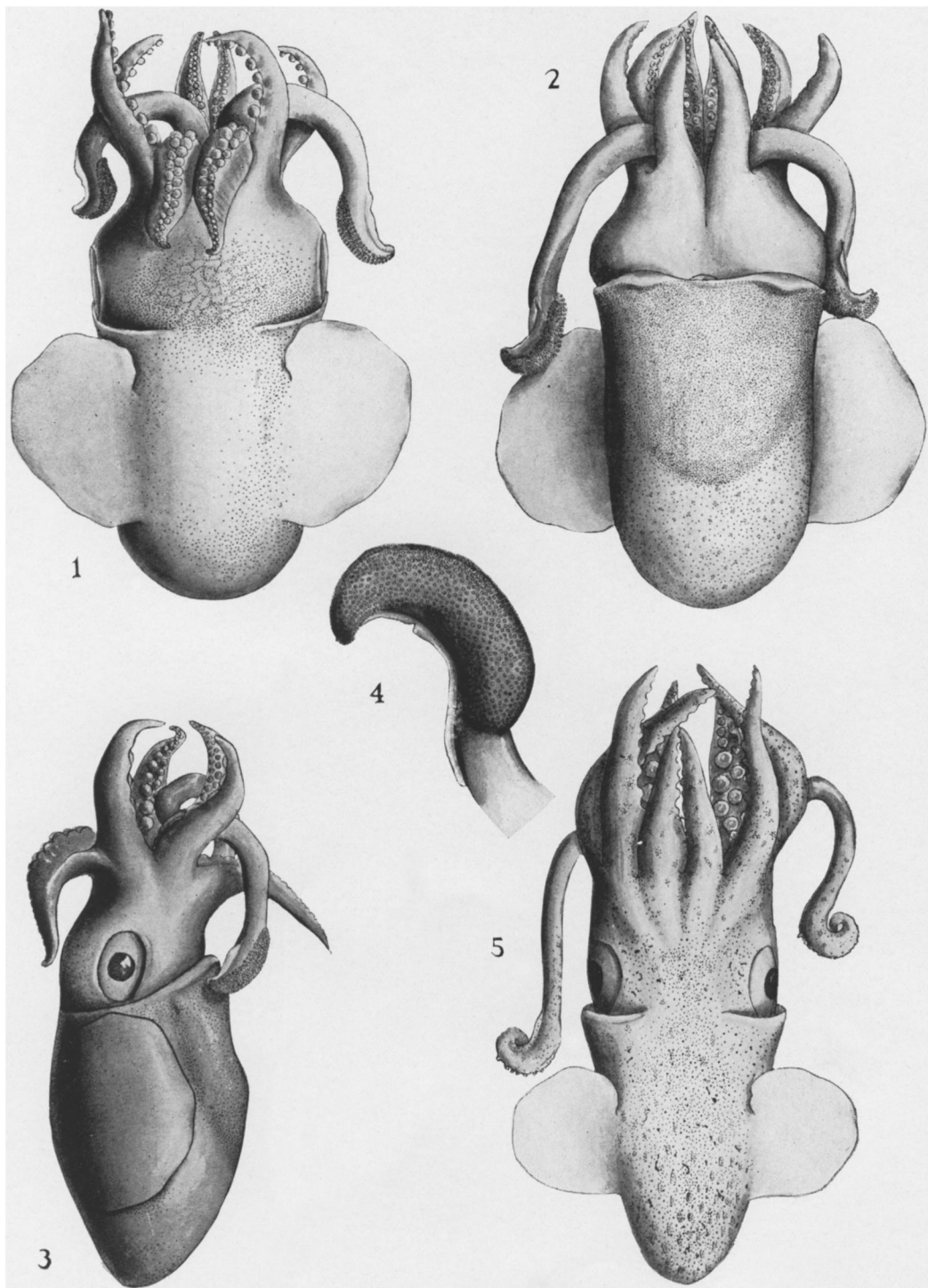
## EXPLANATION OF PLATES V-IX.

- PLATE V.—Fig. 1.—*Stoloteuthis nipponensis* ♂, dorsal aspect of type,  $\times 2\frac{1}{4}$ ; [32].  
 Fig. 2.—Ventral view of same, same scale.  
 Fig. 3.—Right lateral view of same, same scale.  
 Fig. 4.—Enlarged view of left tentacle club of same.  
 Fig. 5.—*Inioteuthis japonica* ♂, dorsal aspect of cotype,  $\times 2$ ; [112].
- PLATE VI.—Fig. 1.—*Euprymna morsei* ♀, dorsal aspect of cotype,  $\times 2$ ; [105].  
 Fig. 2.—Ventral view of same, same scale.  
 Fig. 3.—*Sepioteuthis lessoniana* ♂, ventral view of specimen from Wakanoura,  $\times \frac{1}{4}$ ; [36].  
 Fig. 4.—*Ommastrephes sloanii*, inner aspect of right third arm of specimen from Hakodate, nearly natural size; [257].  
 Fig. 5.—*Sepioteuthis lessoniana* ♀ dorsal aspect of gladius [35].
- PLATE VII.—Fig. 1.—*Abraliopsis scintillans* ♀, dorsal view of cotype, nearly natural size; [147].  
 Fig. 2.—Ventral view of same, same scale.  
 Fig. 3.—*Abraliopsis scintillans* ♀, dorsal view of type, same scale as preceding; [147].  
 Fig. 4.—Ventral view of same, same scale.
- PLATE VIII.—Fig. 1.—*Abraliopsis scintillans* ♀, dorsal view of specimen from Misaki, nearly natural size; [279].  
 Fig. 2.—Ventral view of same, same scale.  
 Fig. 3.—*Abraliopsis scintillans* ♀, dorsal view of another specimen from Misaki, same scale as preceding; [279].  
 Fig. 4.—Ventral view of same, same scale.
- PLATE IX.—Fig. 1.—*Abraliopsis scintillans* ♀, tip of left ventral arm, outer aspect, much enlarged; [147].  
 Fig. 2.—*Abraliopsis scintillans* ♀, left eye of type, lateral aspect; much enlarged; [147].  
 Fig. 3.—*Abraliopsis scintillans* ♀, right eye of type, ventral aspect showing arrangement of photophores; same scale as preceding; [147]. The eyeball has protruded itself through the lid opening.  
 Fig. 4.—*Abraliopsis scintillans* ♀, inner aspect of left ventral arm;  $\times 4$ ; [147].  
 Fig. 5.—*Abraliopsis scintillans* ♀, funnel of cotype laid open from below to show the funnel organ;  $\times 5$ ; [147].

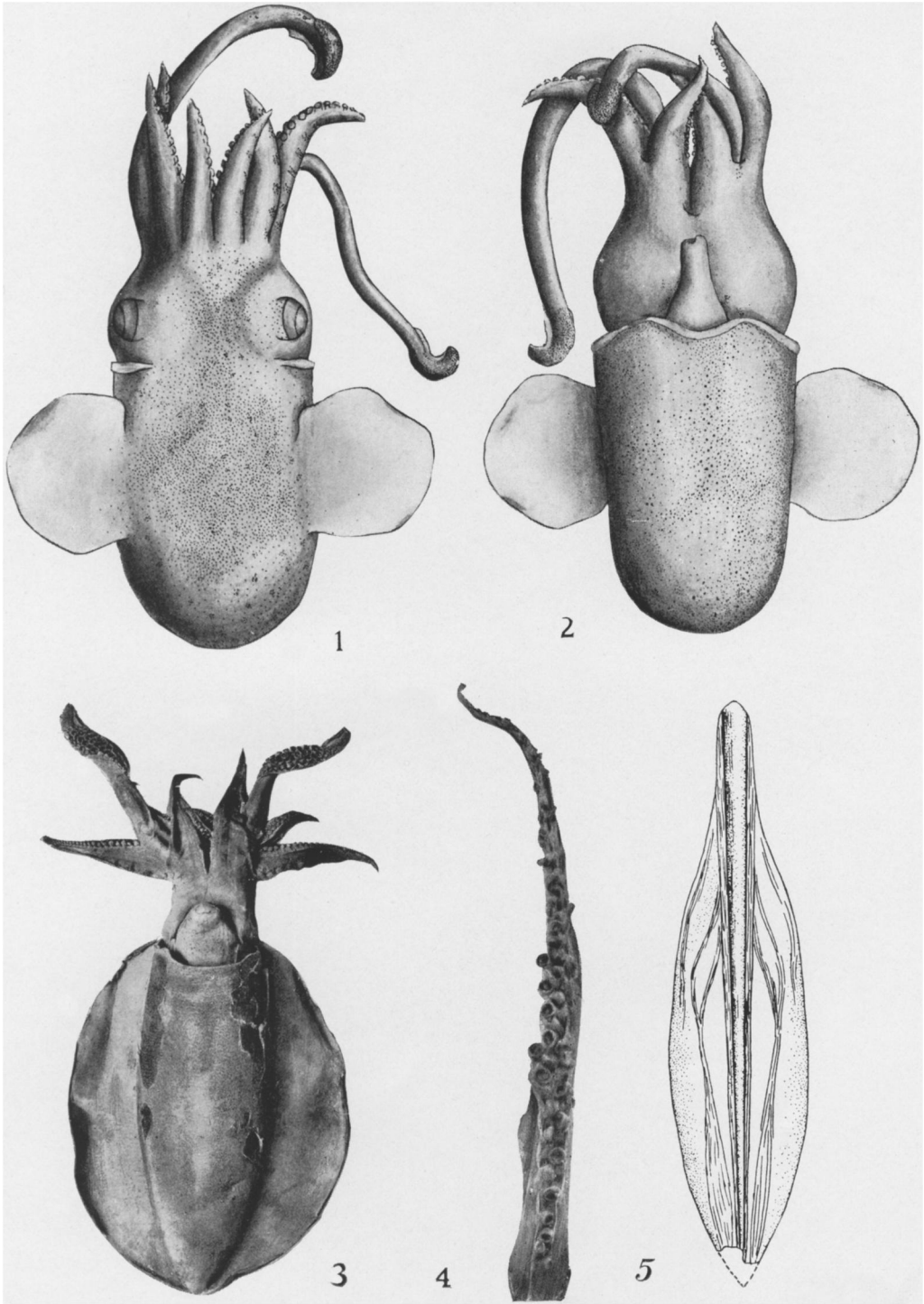
Fig. 6.—*Abraliopsis scintillans* ♀, left tentacle club of cotype, inner aspect, drawn from a mount in balsam;  $\times 13$ ; [147].

Fig. 7.—*Sepia formosana*, left tentacle club of type, inner aspect;  $\times 2\frac{1}{2}$ ; [361]. Drawn by John H. Paine.

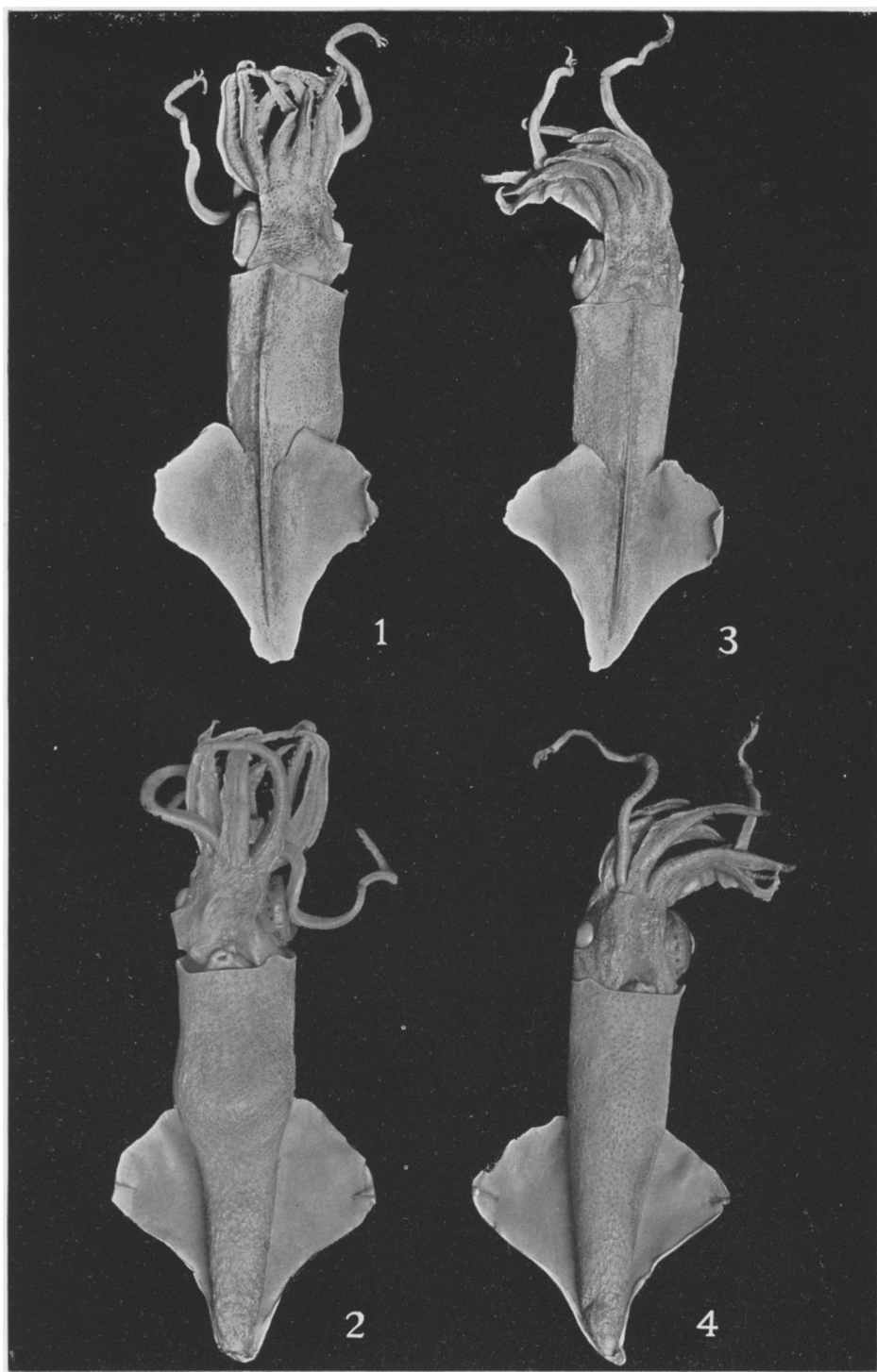
NOTE.—Plates VII and VIII and figs. 3 and 4 of Plate VI are from photographs by Mr. John H. Paine, of Stanford University. The remaining illustrations with the exception of fig. 7 on Plate IX were drawn by Miss Lora Woodhead, of Stanford University.



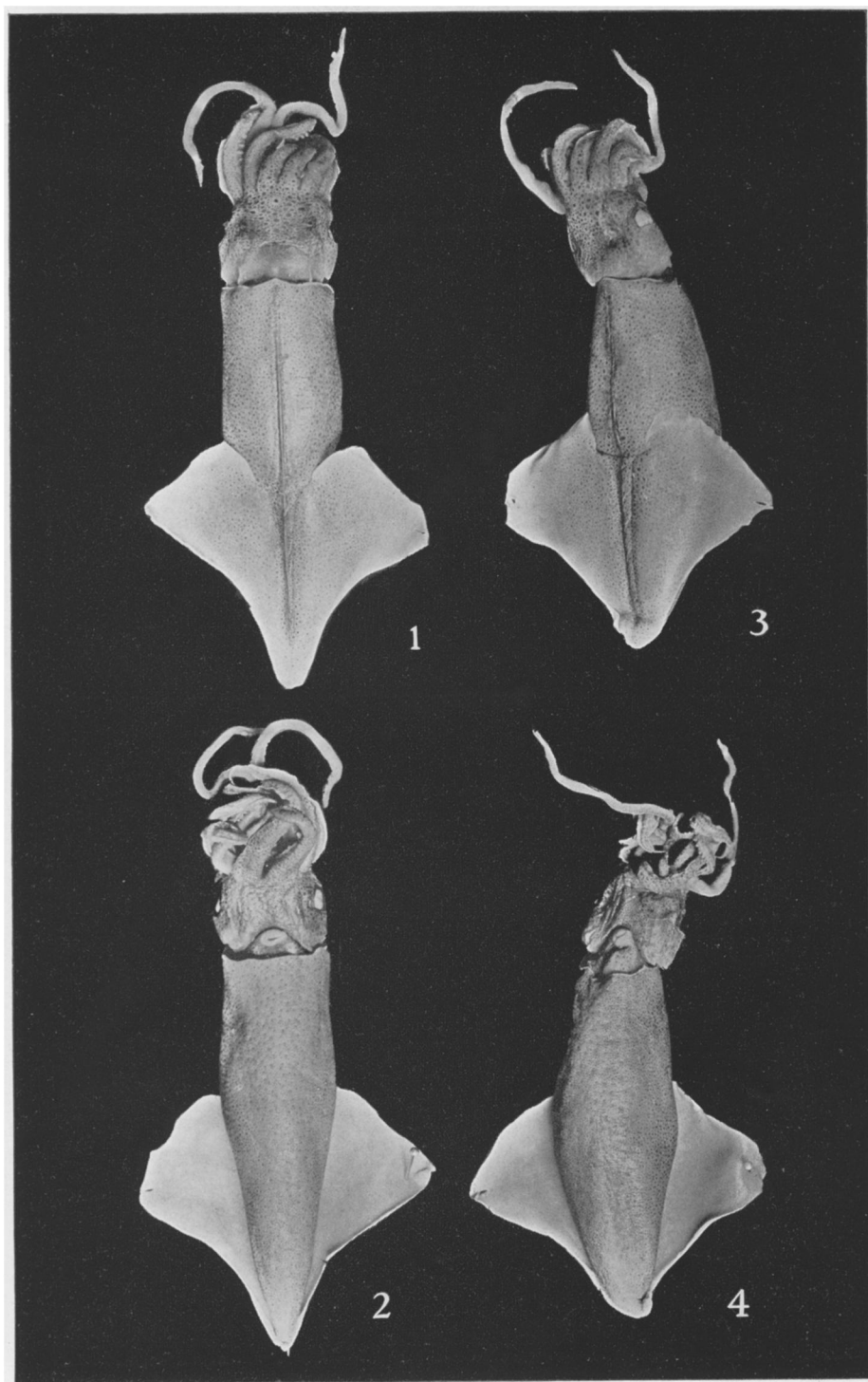
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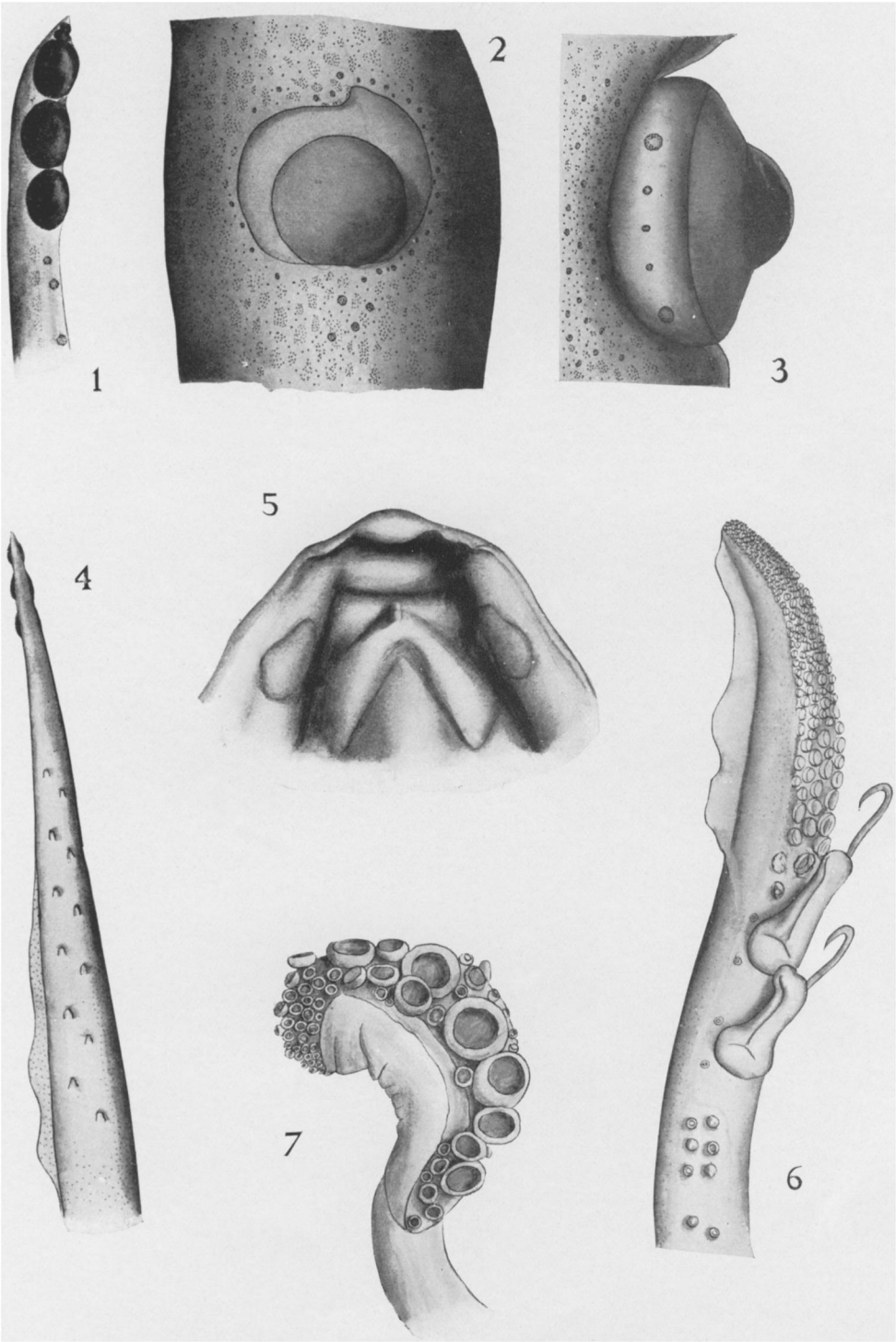
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